73 Amateur Radio

JANUARY 1965

A Chilly 40c

Technical ★ Beginner ★ VHF ★ Transistors ★ Test Equipment ★ DX ★ Mobile ★ New Products ★ Surplus ★ Ham Politics ★ SSB ★ Humor ★ Fiction ★ New Developments ★ Design ★ Caveat Emptor ★ Ads ★ Opinion ★ Cartoons ★ Propagation ★ Emergency ★ Construction ★ Antennas ★ UHF ★ Ideas ★ Quizzes ★ Equipment Improvements ★ Experimenting ★ Theory

73

Magazine

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January, 1965

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Cover: New Hampshire type Squalo mobile. Cast: Bob Cushman (Cushcraft) on left, contained in raccoon coat; Wayne Green in middle; Alrun, genuine Arabian Stallion, the pride of 73 Farms, on the right. Squalo by Cushcraft . . . winter by New Hampshire. Picture by K2YDD.

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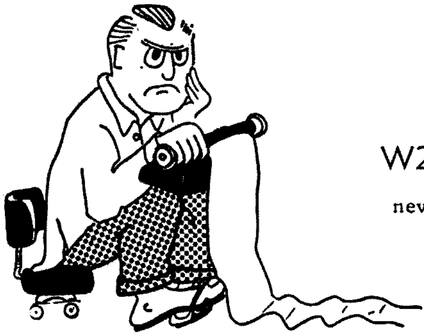

de
W2NSD/1

never say die

The FCC has, at my request, extended the deadline for your comments on Docket 1564, the one that proposes to extinctify the Conditional Class license. Here is a copy of my petition to the FCC in answer to 15640. Since the ARRL seems quite determined to have a maximum of government control of amateur radio I expect that my voice will be lost in the whistle of wind from Newington.

I see this innocuous petition as a major step toward socialism in our hobby, a step that will be difficult if not impossible to ever retrace. Readers, you either speak up now or take what happens to you quietly.

Federal Communications Commission
Washington, D. C.
Re Docket 15640

I believe that the docket, as proposed, would be detrimental to amateur radio and have the following effects:
1. The additional workload which must of necessity be born by the FCC examiners would make it necessary to increase the staff and thereby place an extra expense upon the public.
2. The increased difficulty of taking the exam at a distant examining point must necessarily reduce the number of people able to take the license exam. As a basic policy shouldn't the exam itself be the factor in deciding whether people are able to become licensed amateurs, not the difficulties set up by the government for the taking of the license exam?
There has been considerable criticism lately over the administration of the Conditional Class license, complete with ARRL requests for its elimination. If there is fault with the present system why not try to eliminate the fault? The reasons for the establishment of the Conditional Class license are as valid today as they were when it was established. It is still a great hardship to travel long distances and lose time from work in order to meet an FCC examiner.
I propose that Docket 15640 be rejected and that the present Conditional Class license continue to be administered as at present, with the amendment that the administration of the license exam be by any licensed amateur in the presence of at least two other licensed amateurs, no two from the same immediate family. Any possible problems that might arise due to friendship or favoritism should be reduced to insignificance with three witnesses. Considering the present amateur population there is no area of the country where it should be any hardship to assemble at least three licensed amateurs.
Please act favorably on this petition.

Wayne Green W2NSD/1
Peterborough, N. H.

My prayer is that you will write to the FCC, complete with the lousy 15 copies, and support my proposal to continue the Conditional Class license. The reasons for the license are all still valid. If you got an appointment for a license exam 150 miles away at 9 AM on a weekday what would you do? Would you have a license today? Isn't it tough enough to learn the code and theory without putting a completely unnecessary 300 mile hurdle in the way as well? This would virtually eliminate fellows with fixed office hours such as doctors and dentists from taking the exam. Etc.

Send me a copy of your comments too . . . please?

Just because we are licensed by the government doesn't mean that we have to be completely controlled by it. I'm working to make amateur radio as self-governing as possible . . . but I'm a loser if you don't back me up.

Dannals? Ugh!

I understand that the election for Director in the Hudson Division ended in a tie after one of the heaviest votes ever turned in. Wolfe, W2AGW, is trying to upset the old guard, Dannals W2TUK. I've talked to Wolfe a few times down through the years and have found him to be an intelligent and sincere ham. I've known Dannals quite closely for the last few years and frankly I can't think of anything much more disasterous that could happen to our hobby than to have this guy successfully bludgeon his way to the fame and power that he seems to crave.

The permitting of Dannals to run for Director of the League is another black mark on ARRL Headquarters. They certainly know this man for what he is for he has done their dirty work for them on many occasions. What have we here, another Teamster's Union?

If you are in the Hudson Division, know anyone in the Hudson Division, or even QSO anyone in the Hudson Division please ask them to vote for Wolfe . . . and while you're talking to them find out if they know anyone with a good word to say for Dannals . . . I'd like to hear one. Those that I've heard so far can't be printed. On the first ballot half of the votes were against Dannals, if the secretly counted votes were counted right. Please do what you can to get more ARRL members to vote on the second ballot . . . and to enlighten the half that almost got Dannals elected.

Tours

Several letters have come in recently asking about any future tours. Perhaps it is time I leveled with you on this.

In 1958 the Porsche Club of America de-

cided to run a group flight to Europe. I wanted to go, but couldn't get away for the trip. They easily filled a complete plane and had a lot of members on the waiting list for cancellations.

In 1959 they chartered two planes and I went along. I had a fabulous time. In 1960 I was busy starting 73 had to wave at the Porsche-Pushers on their third annual flight. In 1961 I still couldn't get away. By 1962 I decided that Virginia and I would go whether we could get away or not.

We had such a marvelous time visiting hams all through Europe that we decided that this was too good not to be shared. We started laying plans for a ham flight. I didn't expect any great problem in filling a plane since the Porsche Club had to turn members away and they had a total membership of less than 4000. With 250,000 hams to draw on it should be simple to fill one plane.

Most three week tours of Europe seemed to cost around $900. This obviously was high for the average amateur so I set about figuring how low the cost could be chopped. I added the group plane fare, the cost of good second class hotels which were clean but not opulent and bus expenses. It came to about $550, or some $80 less than the regular tourist class air fare for the same trip. This seemed to me like quite a bargain.

Virginia and I spent a lot of time working out the itinerary. We wanted to get the most travel out of the three weeks . . . to see as much as possible, yet not skim too fast. We decided on starting the tour with London, since this is one of the top tourist points of interest in Europe. Everyone should have a chance to personally visit Westminster Abbey in this life . . . actually stand in Piccadilly, and shop in the famous London stores.

Obviously Paris had to be the next stop. Then Geneva, Rome and Berlin!

The response was disappointingly light to my announcements of the trip and it was soon obvious to me that we were not going to charter a whole jet. I guess my salesmanship wasn't up to the occasion. Just 73 of us went on the trip. I suppose that I should be happy with that since, as far as I know, every other attempt to organize a ham tour has failed completely.

The original idea of the tour was to tak everyone to the five cities and then let the be on their own until time to leave. Well, thi may have been my idea, but we arrived i London and I suddenly found 72 other peopl sitting there waiting for me to tell them wha

Turn to p. 64

120 Watts Mobile on Two Meters

This article, due to its exceptional thoroughness is being published in two parts. This month the construction is covered, next month the tuning up process is described in detail.

Jim Kyle K5JKX
Jim Speck, W5PPE
5421 N. Military
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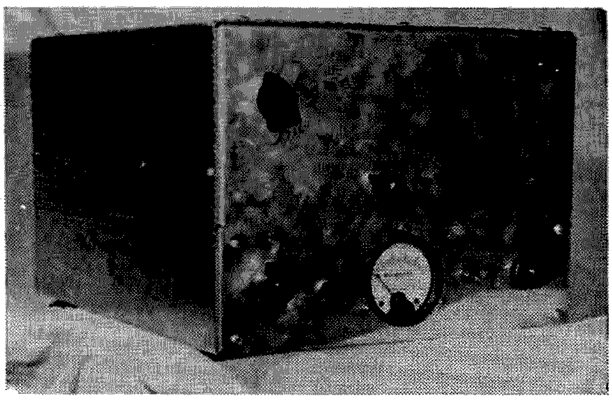


Looking for a quick, simple way to put a hundred and twenty watts on 144 mc in your mobile at almost no expense?

If you are, then turn the page OM because that's not what this rig is. Instead, it's a top-performance rig designed for the best possible signal and the greatest operating convenience, at the lowest cost possible. While it could hardly be classed as a "beginner's project," it's not so difficult that it can't be readily duplicated.

Now, if you're still with us, let's look at how closely this little bomb has filled its design requirements. Starting at the pocketbook (of major interest to most of us) we frankly can't say just what it did cost, since both authors have well stocked junkboxes and access to all kinds of exotic hardware and shop equipment. However, if most parts were purchased new, cost probably wouldn't be over about $125.

For this, we got a stable, clear 144 mc signal of some 80 watts at the output jack, which keys as cleanly as a 160-meter rig and has no detectable spurious output. We also have a modulator featuring full clipping and filtering, with up to 25 db of clipping available and plenty of punch for 100-percent modulation. The entire package, less power supply, is enclosed in a box measuring 8 x 10 inches and 12 inches deep, complete with 12-position crystal switch for rapid QSY without fumbling.

All stages have plenty of power reserve; the driver is rated for more than 10 watts output all by itself. The modulator provides 60 watts sine-wave audio output with no trace of grid current being drawn.

Though designed as a mobile unit, and built around a Swan-transceiver power supply already installed in the car, the rig also works nicely as a home station unit. It has pulled out 10 states in just 3 months of operation from W5PPE, in conjunction with a 32-element array some 75 feet up. It competes easily with higher-powered equipment!

Before we get into the details of duplicating the rig, let's take a brief look at how it works. The driver (from oscillator up to but not including the second 6360) is essentially the ARRL beginner's 2-meter rig, with a tube substitution and some minor changes for added operating convenience. The first 6360 cathode was lifted from ground and tied through a 33-ohm resistor to the key jack. The screen circuit of the second 6360 was modified by adding a pot for drive-level control, and a 2-turn link added to its plate tank. In addition, this stage required neutralizing (not shown on the schematic).

The final is a 5894, with fixed-tuned grid circuit. This is made possible by the generous margin of drive available; the grid coil resonates with the tube input capacity at about 130 mc. Fixed bias of –90 volts (which was available in the Swan supply) was used, permitting exciter keying for emergency CW use.

The plate circuit is a balanced parallel line made of 3/16-inch pipe, with a homebrew plate bypass capacitor at the cold end. Output is taken off through a tuned link, visible in the photos; the antenna relay is built into the transmitter.

The modulator begins with a 12AX7 preamplifier for crystal or dynamic mike, though

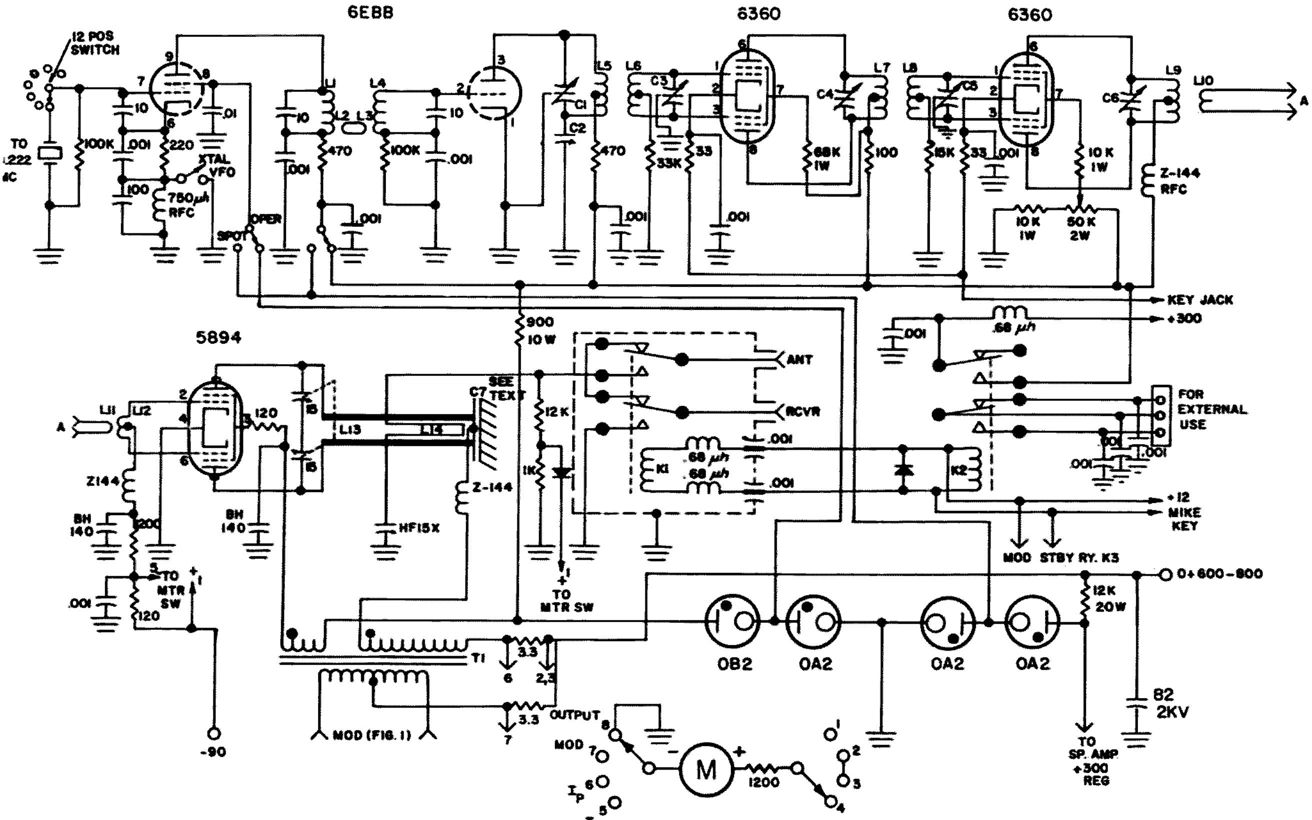


FIGURE 1

:rystal is preferable. Output of the 12AX7 goes hrough a 12AU7 cathode follower to the :lipper, after which it is filtered before being ıpplied to a 12AU7 "cathode" phase splitter. The phase-split outputs are amplified by another 12AU7 before reaching the 807 grids. Hi-fi ans will recognize the influence of the popular Williamson amplifier here.

Fixed bias is also applied to the 807's, with a standby relay to bias them all the way off. he entire power supply to the speech amplifier and 807 screens is regulated at 300 volts by a pair of OA2's.

Metering is provided in the final grid and plate, the modulator plate, and in the output hrough a built-in rf voltmeter.

That's enough description for the moment; we'll get back to theory after everything is put together. Here's how we built it. Feel free to add your own ideas, but watch out for trouble f you make major changes in parts layout. A ig this compact, at this frequency, with speech d rf circuits on the same chassis, is an open nvitation to rf feedback. We had a few battles with it along the way, and no problems exist ith the rig as pictured.

The starting point is a commercial 10 x 12 x 3 chassis. Lay out the parts as shown on the bottom and top view photos and mark all holes. Exact locations of capacitors and transformer-mounting holes will depend, of course, upon the models of components you are using.

With all the holes marked and drilled, you can install all sockets. The 807 sockets submount on metal spacers one inch below chassis level, to allow the height of the rig to be reduced to 8 inches; they could be an inch and a half but we had no spacers that length. The 5894 socket is a Johnson unit, mounted flush from the top of the chassis.

With all sockets in place and properly oriented, filament lines can be wired. We hooked everything up for 12-volt operation since mobile use was the prime purpose. It wouldn't be too difficult to wire the rig for either 6 or 12-volt filament use by judicious series-paralleling of the few tubes with 6-volt filaments.

Next, relay K2 (the open frame unit behind the meter) should be installed and the 300-volt power wiring connected. Decoupling capacitors can go in at this point also.

With all power wiring in place, the rf section can be wired starting at the oscillator and working toward the final.

The sharp-eyed among you will see from the photos that we originally built the rig with a single crystal socket and added the switch and crystal bank later; you can do it either way but if you're putting in the crystal bank you can save the cost of one socket by coming up to the switch arm with bare wire through a ½-inch hole in the chassis. The toggle switch visible near the oscillator tube in the top-view photo is the vfo-xtal switch shown on the schematic.

All if circuits are double-tuned to hold harmonics down. The oscillator-plate and doubler-grid tanks are coupled by 1-turn links, while the other circuits (up to the final grid) are inductively coupled. The photos show the layout clearly; coupling is adjusted by bending the coils more closely together or moving them farther apart. The minimum coupling consistent with good drive to the next stage is recommended for best harmonic reduction.

No special pains are necessary in the rf section through the driver, except for the usual VHF precautions of short lead lengths and point-to-point wiring. Bypass capacitors are used generously, but note that they are not used on the screens of the 6360's. This is not an error; they should be left off here.

The 5894 grid circuit consists of 1½ turns of No. 12 bus-bar wire about 1¼ inch in diameter, from pin 1 to pin 5 of the 5894 socket. One end of a length of ordinary plastic-covered hookup wire is grounded to the rotor of C6 (driver plate capacitor) and the wire is then wound around L9 to form a 2-turn link. It comes straight over to the 5894 socket, is wound into a 1-turn link inside the grid coil, and grounds to the 5894 socket on the far side. The close-up photo shows the details. Though this sounds (and looks) crude, it eliminates one tuning adjustment and provides plenty of power transfer.

The 5894 tank circuit is almost completely homebrew. The lines are built of 3/16-inch pipe, spaced ⅝ inch apart and silver-soldered to a 2⅞ inch square of perforated brass stock. They are bent 90 degrees at a point 2⅝ inches from the plate, and extend a total of 7¾ inches from the plate. At the ends of the lines, ¾-inch flexible shim-stock straps connect them to Fahnestock clips, which make contact to the 5894 plate pins.

At the junction of the shim-stock straps and the lines, additional straps of shim stock are connected and run to the Bud dual-15-mmfd double-spaced plate tuning capacitor. This capacitor is mounted on 0.040-inch plastic, and is completely isolated from ground. The shaft connects to an insulated coupling which runs through the front panel to the tuning knob. Perfect balance of the lines is important; do all you can to achieve and maintain it.

The 2⅞ inch brass sheet at the other end of the lines forms the hot plate of bypass capacitor C7. The dielectric of this capacitor is 0.016-inch sheet phenolic, and it should extend at least ¼ inch beyond the brass sheet all around the edges to prevent possible dc arc-over. The brass-sheet and phenolic sandwich is clamped tight to the chassis with nylon hardware.

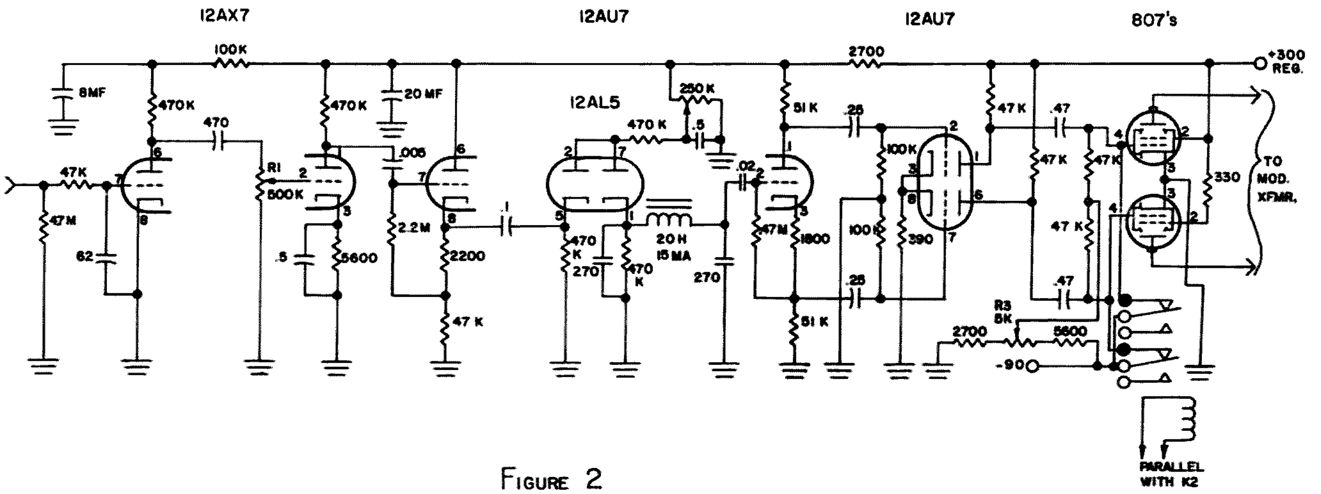


FIGURE 2

Dc connection to the 5894 plate is made through an rf choke visible in the bottom-view photo directly behind the meter switch. The lead from this choke runs through a ½-inch clearance hole in the chassis, through a 1/16-nch hole in the phenolic sheet, to the brass plate, where it is soldered. The other lead goes to the meter switch/shunt assembly.

Rf output from the 5894 tank comes from a link made of No. 12 wire which is insulated ith Teflon tuning. The link is 2¼ inches above the chassis, and 2½ inches long. One end con-ects directly to the bottom terminal of relay 1 (inside the metal shielding box, bottom view of chassis) and runs straight through the hassis in a gum grommet until it is 2¼ inches bove chassis, where it bends to be parallel o the plate line. The other end projects down 1 inch, to the stator terminal of the Hammar-und HF-15x capacitor which tunes the link. he link is entirely self-supporting.

With the rf assembly completed, the front, back, and shielding plates may be bent from heet aluminum and drilled for the appropriate ontrols. The shielding plate should be as far from the 5894 lines as the lines are from the front plate, to preserve balance.

With the rf deck complete, the meter switch an be assembled following the schematic and hotos and, together with the meter, put into lace. Then the rf section can be checked out hrough the final grid circuit.

If all is well, proceed to the audio depart-ent. Though the photos make it look com-lex, the wiring is actually simple. The ap-arent complexity is caused by our striving for shortest possible leads to prevent any rf feedback, with resulting stack-up of parts atop each other.

To wire the audio, start at pin 6 of the input 2AX7 and wire through as the signal prog-resses. Leave off connections to back-panel ontrols R1 and R2 until wiring is complete. Then add connections to the controls, and the two resistors and the capacitor in the grid circuit of the input 12AX7.

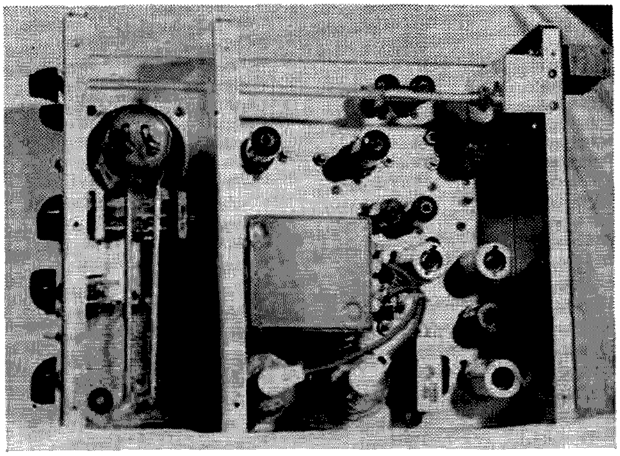
The choke in the filter circuit is a Merit type C-2985, and no substitutions are recom-mended here. With 270-mmfd capacitors at each end, this filter has a cutoff frequency of about 2500 cps, and substantially eliminates all clipping splatter above 5 kc or so.

The only unusual portion of the modulator is the standby relay, K3, in the 807 grid circuits. This relay applies 90 volts negative bias directly to the grids in standby, to cut off the 807's and prevent any current drain. It pulls in on "transmit," and is effectively out of the circuit.

The modulation transformer we used is a Collins Radio Co. item taken from a Collins 618S1 commercial rig, and bearing the part number 677-0537-00. It has separate sec-ondaries for screen and plate of the final-amplifier tube, and is the smallest 90-watt mod transformer we have seen. Its impedance ratings are 5500 ohms plate-to-plate in the primary, 2000 ohms in the plate secondary, and 200 ohms for the screen winding. How-ever, it is working at considerably higher impedance levels in this circuit.

Our transformer had a high-voltage to case short, which was "cured" by insulating the case from ground and then taking special care not to touch the critter (the shielding cage helps in this respect). You might be able to obtain a similar transformer from the surplus stores operated by Collins for their employees. If not, use a 8-henry, 50-ma choke between the 5894 screen and its regulator tubes, and a "universal" 60-watt transformer for modulation.

Visible in the photos but not shown in the schematics is the AM-CW relay which shorts out the plate winding of the modulation trans-former for CW operation. This is a dpdt relay with the normally-open contacts wired to the mod-transformer plate-secondary ter-



Top view of chassis shows general parts layout. 5894 occupies compartment at left. In line from 5894 to crystal switch are 6360's and 6EB8. Two VR tubes are below crystal-switch shaft, other two are directly below them. Modulator starts with 12AX7 at lower right, with 12AL5 directly above and a 12AU7 above that. Second 12AU7 is directly to left of first one, while 807's are directly below mod transformer.

minals, and the arms connected together. One end of the coil goes to +12 volts, while the other end runs to the fone-cw switch on the back panel. This switch is a spdt with its arm grounded; in the cw position it grounds the mod-xfmr relay, and in the fone position it grounds the key-jack lead.

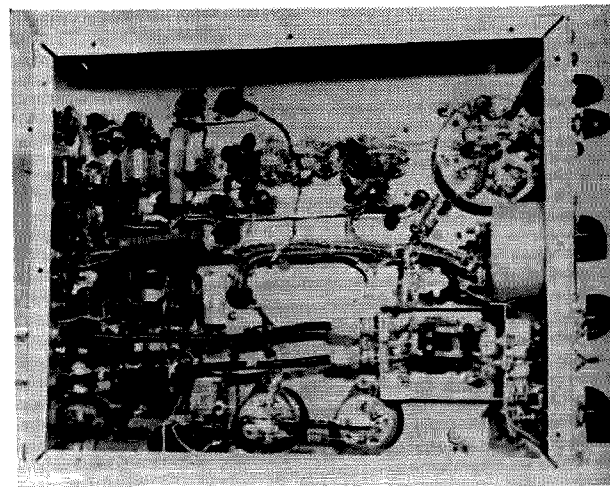
Because this relay carries modulated B+, which can reach 1600 v on positive peaks of modulation, it is also insulated from the chassis, and the shield of the tube nearest it is wrapped with fiberglas insulating tape as an added precaution.

With rf and audio wiring complete, all that remains to finish the job electrically is to install the rest of the control circuitry, the rf output meter components, and the back-panel cabling.

The major item in the control circuitry not already hooked in is the antenna relay, K1. This is an ordinary dpdt relay with a 12-vdc coil, but is enclosed in a small chassis box as shown in the bottom-view photo. We took the lid off the box for the photo so you can see what's inside.

The output link runs through a hole in the box directly to its relay terminal. Antenna and receiver connections through the box are made with coax fittings; we used BNC because we had them on hand but any other small coax fitting would do as well. The shields *must* be grounded at this point to prevent leakage, so don't just run coax through holes in the box.

The relay coil wiring is decoupled with



feed-thru capacitors, and .68-microhenry rf chokes between the feed-thrus and the coil itself. The feed-thrus are visible at the front of the box.

Rf voltmeter components are inside the box also, and the dc output to the meter switch also passes through a feed-thru capacitor. A silicon power diode is best for the rf voltmeter, since 80 watts on 50 ohms comes out to be a little over 60 volts, and the IN34 series is rated for only 50 piv.

Also in the interests of diode protection, the meter switch wiring should be changed a bit from that shown in Fig. 2. The change consists of interchanging the Ig and Mod positions of the switch, so that high-voltage contacts aren't located immediately adjacent to the rf voltmeter contacts. We built it the way it's shown and arc-over between contacts has killed two diodes for us so far!

With electrical hookup complete, only one step remains before tune-up and testing. That's to install the shielding cage. It's made from Reynolds do-it-yourself stock, bent to shape and secured to the lips of the plates with No. 4 sheet-metal screws. A bottom plate, not shown, completes the shielding.

Tune-up and adjustment procedures for this rig divide into two parts, rf and audio. Experienced VHFers won't need much direction for either, but if you do find that you need help we'll have the second part of this article next month, giving you step by step tuneup instructions.

How to build a transistor
AM transmitter that works.

Leonard Geisler

AM, the Amateur and Transistors

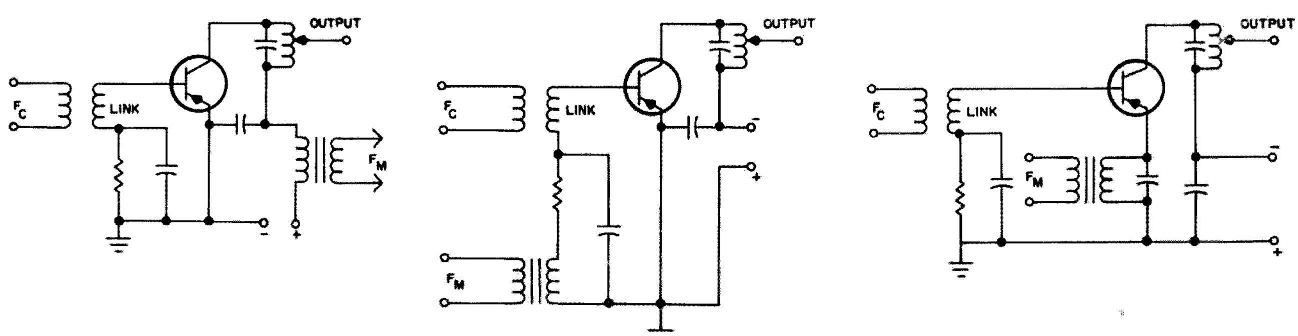
Now that transistors are plentiful and the low and medium power high frequency types are priced within reason, there is no excuse whatever for the amateur to continue working with cut and dried vacuum tube circuitry. We shall endeavor to clear away the fog of misinformation and misconception by a small amount through presenting some of our proven circuits here.

There have been several half-truths circulated in the literature about amplitude modulating transistor transmitters. It has been stated that it is a) difficult to 100% modulate a transistor final, b) driver stages must be modulated, along with the final, to obtain good overall depth of modulation, c) linear modulation of transistors is very difficult, so a) and b) are true. We shall try to dispel this gloom.

Shown in Fig. 1a through c are representative diagrams illustrating how amplitude modulation is applied to a transistor transmitter power amplifier or final. Any of the circuits will work properly, provided alignment of the final tank is done with extreme care.

When the tank is tuned for maximum CW output, it is virtually impossible to linearly modulate the transistor; a) in the foregoing paragraph is therefore true.

If we apply rf drive to the final and tune its tank while a steady tone is applied to the modulator transformer, it is possible to peak the amplifier output so that we can obtain a very large amount of rectified—or demodulated—audio across the load resistor. An oscilloscope properly connected to the modulated transistor amplifier will show a clean trapezoid pattern, indicating 100% modulation at some given af input level. However, if we measure the unmodulated carrier output of such a transmitter tuned in this fashion, we will find it far less than it is when we tune for maximum CW output. This then proves that a) above, is untrue. The true statement should read, "It is impossible, under the usual conditions associated with CW tuning of a transistor amplifier, to obtain linear or 100% modulation." With this interpretation, we can safely assume the rest of the statement is subject to further clarification, and research.



COLLECTOR MODULATION, HIGH LEVEL, HIGH Z.
A.

BASE BIAS MODULATION, LOW LEVEL, MEDIUM Z.
B.

EMITTER MODULATION, INTERMEDIATE LEVEL, LOW Z.
C.

FIG. 1 CONVENTIONAL AM CIRCUITS.

The subterfuge of modulating the earlier stages of a transistor transmitter as recommended by some [1] is really not an elegant solution to the problem, *even though it works*. It is my firm conviction that the best solution to a problem is to avoid it in the first place. Fig. 2 illustrates a better way.[2]

Here, modulation is applied to both the emitter and collector, 180° out of phase. What happens, in effect, is that the base-emitter voltage, hence the gain of the transistor, is varied simultaneously with the increase and decrease of the collector source voltage by the modulating waveform. The modulated transistor is always kept operating in class C throughout the modulating cycle and linear—100%—modulation is easily attained.

We should mention here that by comparison, the multi-stage modulation systems mentioned in reference (1) operate with the final transistor working as a class B *non-linear* amplifier during nearly half the modulating cycle, so a high degree of inefficiency may result.

The combined emitter-collector modulator is capable of being operated at both high efficiency and high power. A transmitter of a given final dc input power using multi-stage modulation, and a comparable dc input to a combined emitter-collector modulated transmitter will show, in actual tests, that the simpler combined system is greatly superior.

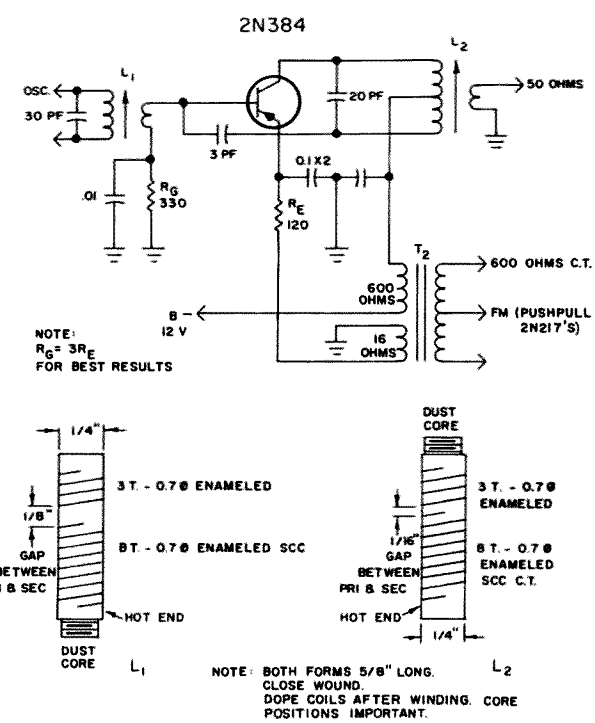


FIG. 2

Fig. 2. Combined emitter-collector circuit. Modulates linearly.

Unmodulated carrier power of the emitter-collector modulated transmitter will nearly equal full CW output. This means, with linear modulation, we are able to obtain full ICAS output from a low power transistor. In the practical circuit of Fig. 2, we show the modulator transformer as having a 600:16 Ω impedance ratio between the two secondaries. With other transistor types, it will be necessary to adjust the impedances to match the power level you intend to operate your own transistor at.

We now come to the "something-for-nothing department."

Economy of space and battery power dictate highly efficient systems must be used with the rapidly-becoming-popular types of personal portable communications gear. This means we must use the most simple, yet effective, system possible in both the transmitter and receiver. Such a system is the well known DSB transmitter with a simple locked oscillator bfo in the companion receiver for carrier reinsertion.

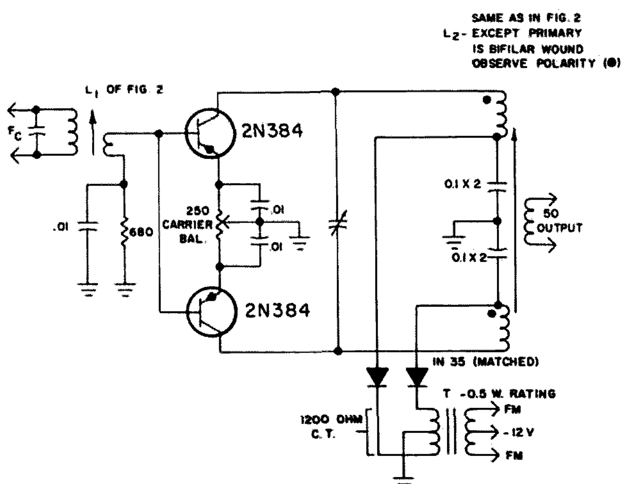


FIG. 3

Fig. 3. Brute force DSB. The louder you yell, the better you get out.

Considering the fact that the personal portable radio-telephone (the handie-talkie) is generally intended for fixed frequency communications between net stations, the oscillator frequency of all sets is crystal controlled. It is relatively simple to make sure all crystals match within a very few tens of cycles by ordering them from one supplier. If the receivers are also crystal controlled, using closely matched crystals obtained from the same manufacturer, we only have to worry about the receiver bfo. A locked oscillator, similar to those used in FM stereo multiplex adaptors, except for frequency—which should be that of the set's *if*—will generally suffice under most conditions.

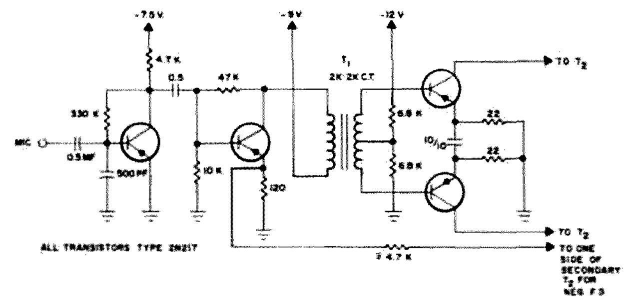


FIG 4

Fig. 4. Amplifier-Modulator.

Now that we have taken care of the "minor" details, let us continue. One highly efficient DSB transmitter final is shown in Fig. 3.

The credit for the original idea should go to John Palmer, KH6EGP. The author built the test circuit, found it worked—better than anticipated—and is passing it on to you for your information.

This circuit functions somewhat like the screen-grid DSB transmitter originally developed by an associate of Costas. There is one exception however; transistors have no screen-grids!

Rf excitation is applied in parallel to the bases of the final transistors, while their collectors are wired in push-pull. This results in carrier cancellation when no modulation is applied. Audio power is fed in push-pull to the final collectors, keying the transistors *on* alternately on each audio cycle. This generates an rf output which contains no terms of f_C or f_M, but only the upper and lower sidebands. (Any unbalance is adjusted by the 250 Ω emitter potentiometer.)

Sufficient power is available from the modulator amplifier to supply full rated dc input to the DSB generator transistors. There is no need to connect the final to the battery. By using this kind of modulator-cum-power supply, we save on primary battery power, as the final draws power only when you talk. (The louder you yell, the better you get out!) The oscillator operates while the press-to-talk button is held down, however. In order to prevent "pumping" it is recommended that a large electrolytic capacitor be shunted across the battery supply, say about 500 mfd.

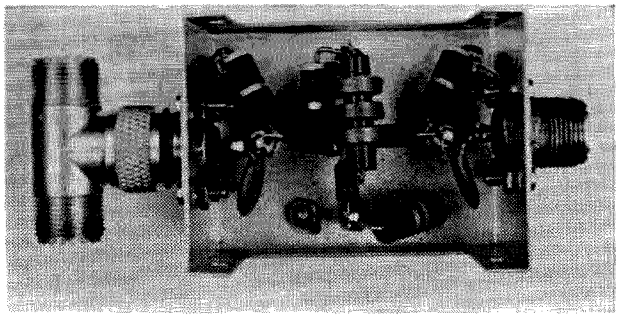
It is necessary to prevent distortion in the modulator. Heavy negative feedback keeps the modulator power output stage matched to the load at all levels of speech input. The audio amplifier circuit we used is shown in Fig. 4.

. . . Geisler

1. Pacific Semiconductors Applications Notes, "Citizens Band Transmitters," by George G. Lentigerau and Joseph E. Mackey.

2. Electronic Design, Oct. 11, 1962, "Linear Modulation of Transistor Power Amplifiers," by Leonard E. Geisler.

Let's keep it simple #2. The ideal T-R switch; Fast, low loss, simple, cheap—and no TVI.



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Diode Controlled Break-In

The search for the perfect T-R switch will continue for many years to come. The coax relay is hard to beat when one considers its broad bandwidth, its 100 db isolation, and its almost zero insertion loss. However, it is ponderously slow, it is noisy, and the best ones can cost a buck per db of isolation. What we require is a switch that will operate quietly and quickly, one which has low insertion loss and which is cheap and easy to make.

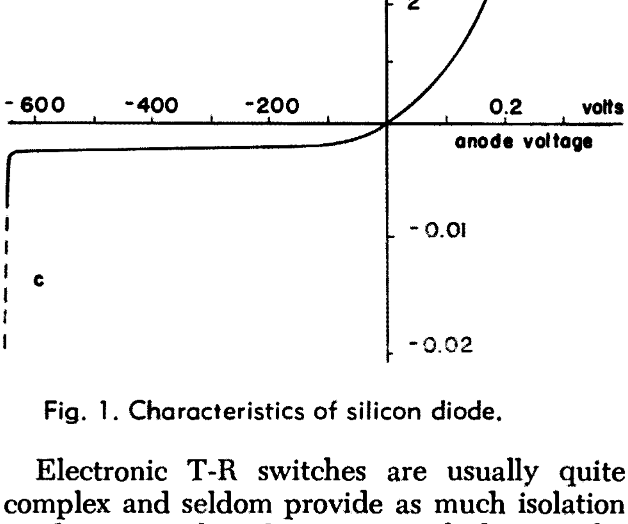


Fig. 1. Characteristics of silicon diode.

Electronic T-R switches are usually quite complex and seldom provide as much isolation as the coax relay. Some give a little gain for reception; most will degrade the receiver's performance. Some must be retuned as bands are changed. Many carry the hazard of TVI. A few are extremely tricky to adjust. The magic tee, ferrites, and coax and waveguide diode switches come into their own at UHF, but these techniques cannot easily be used in the HF bands.

The T-R switch described here will give about 80 db of isolation, less than 2 db insertion loss, and fast, silent operation; it is broadband, calls for a minimum of adjustment, and, above all, it is simple to build.

As the title tells, the active element is the diode. In fact we use the silicon diode. The characteristic (Fig. 1) shows that, depending upon the polarity of the applied voltage, the silicon diode either conducts heavily or (almost) not at all. In other words it is very much like a switch, where the switch's "handle" is replaced by the applied voltage. Whatever we do, we must be extremely careful not to operate the diode on the part 'C' of its characteristic, because the high dissipation in this so-called 'breakdown' region is destructive.

Let us investigate the silicon diode a little further. A forward biased diode (one with a positive potential applied to its anode) will conduct heavily. Under these conditions it presents a low impedance to a superimposed rf signal as well, providing the peak-to-peak amplitude of the rf is less than twice the available bias voltage. A reverse biased diode (one with a positive potential applied to its cathode) will pass hardly any current at all. It presents a very high impedance to dc. To an rf signal it will also present a high impedance, but the value of the impedance to rf will be lower than for dc. The reason for this differ-

ence is the fact that the diode possesses a certain amount of capacity, which passes the rf but blocks the dc. The impedance of a reverse biased diode therefore decreases with increasing frequency, but even at 30 mcs it will still be several thousand ohms if the bias is great enough.

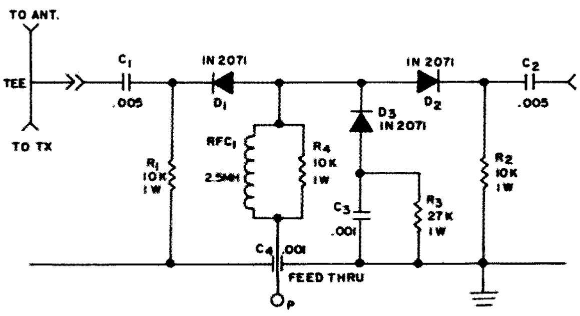


Fig. 2. T-R switch.

These ideas may now be applied to the T-R switch, the circuit of which is shown in Figure 2. The resistors form dc circuits for the bias current. They have values that are high in comparison to the impedance of the coax line, and so they do not shunt the signal excessively. The capacitors are there to block the dc and to pass the rf where necessary. Diodes D1 and D2 are biased in the same direction. D3 is biased in the opposite direction. Suppose we apply a positive potential at the point 'P'. Diodes D1 and D2 will conduct and diode D3 will be reverse biased and will not conduct. Thus diodes D1 and D2 present low impedances while D3 presents a high impedance. Under these conditions an rf signal from the antenna will be passed to the receiver with little attentuation.

Suppose now that we apply a negative voltage to the point 'P'. Diodes D1 and D2 will no longer conduct. D3 will be forward biased and will conduct. Therefore diodes D1 and D2 will present high impedances and D3, a low impedance. Rf from the antenna or from the transmitter will now be confronted by the high impedance of D1. A certain amount of the signal will leak past D1, only to be confronted by another high impedance, that from D2. A much easier path for any rf that does leak past D1 is to ground through the relatively low impedance of D3 and C3 in series. Accordingly, very little signal will now be able to reach the receiver.

Practical Considerations

It is now pertinent to decide upon the values of the components in the circuit and the voltages necessary for switching purposes. Let us first consider the operation of the device in its receiving mode. Signals will generally be quite small with voltages across the coax line seldom exceeding a few millivolts. Therefore, if the bias applied at the anodes of D1 and D2 is + 1v or more, the impedance through the unit will remain small for all signals.

During tests of the prototype, it was found that increasing the bias voltage above about + 10 volts at 'P' did not reduce the insertion loss materially. For general operation in the receiving mode, it is recommended that about + 30 volts be applied at 'P', but anywhere between + 10 and + 100 volts should prove satisfactory. From the point of view of heat, it is better to keep to the lower values of bias, since resistors R1 and R2 will be dissipating all their power in the close vicinity of the heat-sensitive diodes.

In exceptional cases, for instance, when a powerful transmitter is located nearby, cross modulation may be experienced, but an increase in the bias voltage should eliminate the problem. For a similar reason the bias supply must be well regulated, otherwise the slight change in transmission characteristics of the switch with changes of bias will modulate incoming signals, and hum will be apparent on them all. It should be remarked here that these effects have not been noticed under normal operating conditions. Only very strong signals cross-modulate (A closely coupled gdo will). Filtering on the author's transmitter, an RC filter at that, has proved adequate, and no hum has been detected during reception. However, with *no* bias the hum is severe.

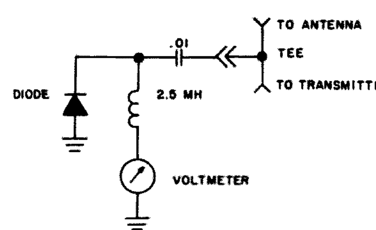


Fig. 3. RF voltmeter.

Now we come to the bias requirements for the transmitting mode. It is possible to obtain the bias voltage directly from the rf output of the transmitter, but a number of disadvantages are associated with this method. TVI is one. Another is that large pulses of rf would reach the receiver at the start of each morse character, since there would be no provision for sequential keying. Also, for adequate isolation, a rather high voltage is necessary.

Tests were made with a signal generator having an output of a few volts. When a bias of - 6 volts was applied at 'P' the device had

an isolation of 50 db. For increases of - 2 volts under these conditions there were increases of 1 db in the isolation. With - 120 volts applied at 'P' the attenuation reached 80 db. The available test gear was not sufficiently sensitive to measure any further increase in isolation.

We now know that the reverse voltage across the diode D1 must not be less than - 120 volts for proper isolation. Let us allow a safety factor of 30 volts, and make it our criterion that, whatever the signal from the transmitter, the voltage across D1 must be at least - 150 volts. A transmitter with an output of 100 watts will produce a peak-to-peak of 200 volts across a 50 ohm line. This peak-to-peak voltage will be centered on the bias voltage applied to D1 and will swing the voltage across D1 from 100 v greater than the bias to 100 v less than the bias at the rf rate. To meet our criterion, therefore, the bias must be at least - 250 volts in this case. To ensure that the diode is not operated in its breakdown region, its piv should be at least 350 volts. If we allow a 50 volt safety margin, then we must choose a diode with a piv of 400 volts.

The figures given above are correct if the coax line has negligible VSWR, and if the output of the transmitter is relatively free of harmonics. The voltage will vary from one place to another along a line with a high standing wave ratio, and if the switch is connected at a point of high voltage the diodes may be destroyed. It is simple to calculate the necessary PIV for any given transmitter power when the VSWR is low. Allowing for the safety margins mentioned above, we can calculate the PIV from the formula,

$$\text{PIV} = 200 + 21\sqrt{P} \qquad \text{(50 ohm line)}$$

$$\text{PIV} = 200 + 26\sqrt{P} \qquad \text{(75 ohm line)}$$

where P is the transmitter output power. Table 1 gives the value of piv necessary for a number of given output powers.

TABLE I

DIODE PIV	P-P XMTR VOLTAGE ACROSS COAX	XMTR PWR OUT (WATTS)* 50 ohm	75 ohm	OPTIMUM BIAS VOLTS
400	200	100	66	250
600**	400**	400**	260	350**
800	600	900	600	450
1000	800	1600	1050	550

* Power values for CW.
** Author's unit uses 600 volt diodes, 350 volts bias, with a 150 watt transmitter. All other values untried.

It is quite simple to measure the voltage across the coax, however, and eliminate the possibility of destroying the switch. All that is needed is a peak reading voltmeter like that illustrated in Fig. 3. The diode and capacitor should have voltage ratings greater than the voltage expected across the line. The meter should be as sensitive as possible (absorb little power) and it should be used on its highest range for greatest accuracy. However, even a meter with a basic movement of 1000 ohms per volt will introduce only a small error. Whatever meter you use, add 10% to the value you measure to be certain that you do not underestimate the voltage present—after all your meter may be reading low and the choke you use may not be too good. Be sure to measure at the point where you intend to connect the switch. This measurement will tell you the peak voltage across the line. Double it (to find the peak-to-peak), add 200 v, and that will be the minimum value PIV for your installation. The value of bias for a given transmitter is determined by adding 150 v to the value measured by the peak reading voltmeter. A higher bias may be used providing the diode you select has a high enough PIV.

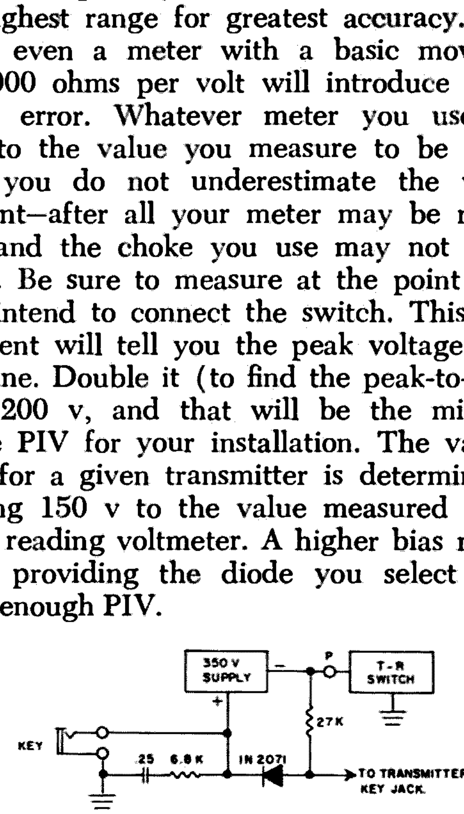


FIG.4

T-R switch hook-up.

Other components in the circuit are not so critical. D2 has to withstand the transmitting bias, and for convenience may be the same type of diode as D1. D3 has only to hold off the receiving bias and may have a lower rating than diodes D1 or D2. The capacitors should have reactances that are low compared with the line impedance, and the resistors should have values that are high compared to the line impedance. The choke should have no series resonance falling in or near a ham band, and it should present a reactance of several thousand ohms over the ranges on which it is to be used. R4 damps any tendency for ringing to occur due to the presence of the choke. Although C2 will normally have to withstand only the receiving bias, C1, C3, and C4 all must hold off the transmitting bias or the peak coax line voltage, and it may prove convenient to choose all the capacitors to stand the transmitting bias. Doing so when D2 has the same PIV as D1 might prove a useful feature, since the transmitter could be connected to either end without damage occurring. About 10 ma should flow through D3 in the transmitting mode, and one or two milliamps should flow through D1 and D2 during reception. The details giv-

en above should serve as guidelines for anyone who wishes to design his own switch.

Construction

The photograph shows the layout of the unit built by the author. It is housed in a 2¾ × 2⅛ × 1⅝" minibox. The heat-producing resistors are kept away from the diodes, and the imput and output circuits are arranged to minimize their mutual coupling as much as possible, thereby improving the isolation. The 2 watt resistors are not essential, and the 1 watt types specified in Fig. 2 will normally be satisfactory. However, for phone operation the dissipation of R3 should be checked to make sure that it is not being overrun.

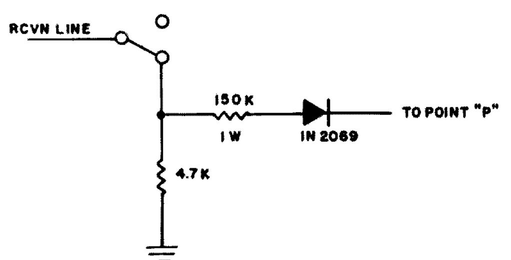


Fig. 5. AVC-MVC modification in receiver.

The diodes are supported on low capacity ceramic standoffs arranged down the center of the box. Capacitors C3 and C4 are mounted to the side. C4 is a ceramic feed-through and carries the bias current.

Control

There are many ways in which the biasing voltages can be applied. The method described below shows how another diode may be used to do some of the work.

Seventy volts appears across the contacts of the author's key when it is up. This voltage is used to bias the diodes in the receiving mode. A 27k resistor is connected in series with the 70 v line to the switch, as shown in Fig. 4. A diode is placed in series with the lead to the key with its anode towards the transmitter. A 350 volt supply, with its output floating is connected from the switch to the cathode of the diode. When the key is up, the diode is back biased by the 350 volt supply. No current is drawn through the diode; the 350 volt supply is isolated. However, current can flow from the transmitter into the t-r switch and bias it for receiving. When the key is depressed, current is drawn through the t-r, through the 350 volt supply via the key, thus biasing the t-r switch for transmitting. At the same time the back bias is removed from the diode (Fig. 4) which becomes a low impedance and the transmitter is keyed.

The CR circuit across the key contacts is there to prevent the t-r switch from returning to the receiving condition before the rf from the transmitter has had a chance to die away. The capacitor has to charge to about 200 volts before the negative bias is removed from the switch, and this takes several milliseconds. As the switch switches over to isolation in less than one millisecond, the shaping circuit in the transmitter prevents too much rf from being developed before the switch is in the transmitting mode.

A further embellishment of the circuit may be noted. Again we can use a diode to do some switching for us. The negative bias applied to the switch during transmission can, at the same time, be used to bias the rf stage of the receiver and reduce its sensitivity. The diode isolates the receiver from the + 70 volts applied to the switch during reception. Fig. 5 shows the arrangement used by the author. In the mvc position the avc/mvc switch normally grounds the avc line. The ground connection is removed and a 4.7k resistor soldered in its place. The switch side of the resistor connects to the 150k resistor and diode in series. A lead is taken from the cathode of the diode to the point 'P' of the t-r switch. In normal operation the 4.7k resistor makes no difference to the manual volume control, and, of course, it is out of circuit for avc. In other installations the value of the 150k resistor can be changed to suit individual requirements.

If *all three* diodes in the switch are reversed, a negative bias will be required for receiving, and a positive bias for transmitting. This alternative configuration may prove useful where the available voltages differ from those described above. There are very many ways in which biasing can be effected, and the reader will no doubt discover the method most easily adapted to his own needs. It is perhaps appropriate to include the circuit of a simple power supply that can be used with, say, the receiver power transformer, to supply the transmitting bias. It can also be used with a filament transformer and more filtering to provide the receiving bias. Fig. 6 shows a voltage doubler circuit that has a floating output. It can be used either for negative biasing as shown, or for positive biasing simply by reversing the connections to the output. The resistor R is adjusted to give the correct voltage at the point 'P' of the switch under operating conditions.

Conclusion

The diode T-R system described above has proved extremely reliable and effective. The arrangement switches so quickly and cleanly that only a slight click is heard at the start of

each morse character. The click is presumably caused by the sudden change in the receiver's parameters as the negative bias is applied to the rf and *if* stages. The recovery to full sensitivity, which, to the ear, seems to take place instantaneously, is clean and free from clicks. During transmission the receiver gives a pure S8 monitoring signal.

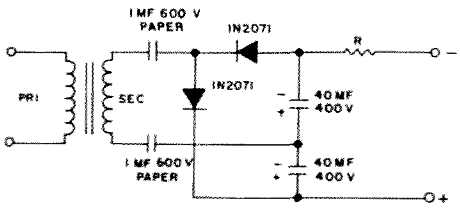


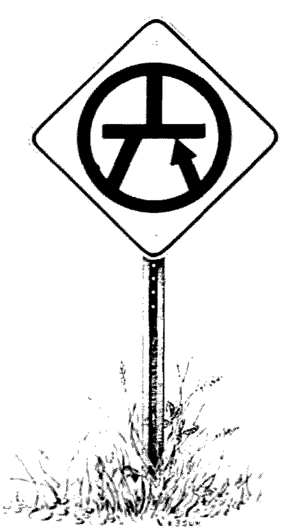
FIG. 6

Voltage doubler power supply.

Loss of sensitivity during reception is negligible. The switch's insertion loss was measured as less than 2 db over the range from 10 to 30 mcs, and there is no reason to expect any great change down at 3.5 mcs. As 2 db is substantially less than one "S" point it would remain undetectable under most circumstances. The diodes add little noise to the circuit since they are not matched to the line.

Some people may suspect that diodes at the output of a transmitter would produce nothing but TVI. As the TVI from a diode is a result of operating it over a non-linear portion of its characteristic curve, we have made certain that this does not happen. No TVI has been introduced at the author's installation, although the TV antenna is only 6 feet from the transmitting antenna and the TV station is 130 miles away.

. . . VE2AUB/W5



Capt. John L. Reinartz, USNR, Ret. K6BJ

Radio Calibration—How To Get It

This article, written shortly before his death, is the last work of one of amateur radio's most important pioneers. We are very proud that John chose 73, over all other ham magazines, to publish his articles for the last few years.

I was much taken with the article by Conway Wilson in the April '61 Issue of 73 Magazine. However, he left out the 'how to get it,' and because I had been faced with such a problem many years ago, the solving of it may be of interest. We all know what a potentiometer bridge is and that in conjunction with a standard cell we are able to measure an unknown voltage. It is merely the inability to find these potentiometer bridges on the surplus market that prevents their general use. So we substitute.

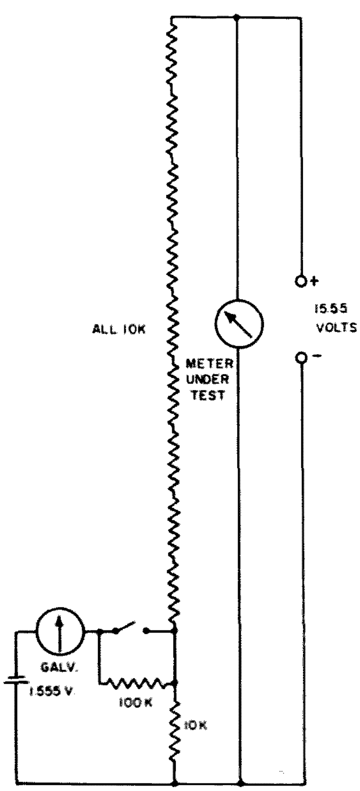


FIG 1

To refresh our memory let's look at Fig. 1. If we have ten good 10000 ohm resistors that have all been checked to 1% or better of being alike, we connect them all in series and we have a good start on a potentiometer bridge. Any voltage across the entire ten will now be the sum of the separate voltages across each one. If we had a standard cell connected from the start of the series of resistors and through a galvanometer to the junction of the first and second resistors and adjusted the voltage across the entire ten until the galvanometer read zero, the voltage across the entire ten would be ten times the standard cell voltage and probably 1.0192 times ten or 10.192 volts. Also, from the bottom up each resistor tap would give us a proportionate voltage. Consequently, if we had 100 resistors, the voltage across the stack would have to be 101.92 volts to balance the standard cell voltage across the first resistor.

Now not only don't we find such expensive potentiometer bridges on the surplus market, neither do we find standard cells there. These cost too much nor do we need them every day. Therefore a substitute is needed that will serve as well and with just about the same accuracy. So we do start with ten 10000 ohm resistors of 1 watt rating and all 0.1% accuracy if possible. If not we will be satisfied with 1% acuracy. Also we need 1 resistor of 1010 ohm value and another of 2040 ohm value. With the total combination we are going to be able to have ratios of 2, 3, 4, 5, 6, 7, 8, 9, 10, 50 and 100 to 1 of the voltage we are going to use as a standard in place of the

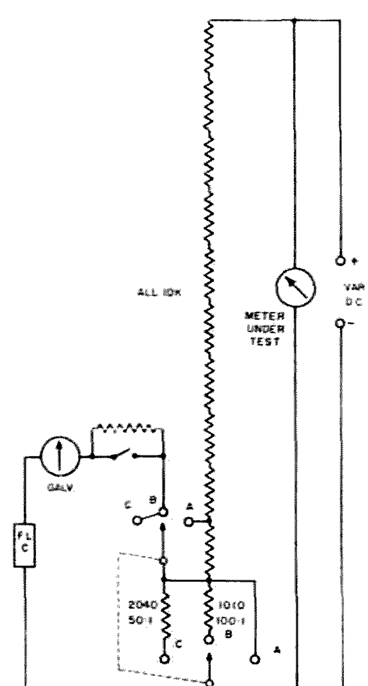


FIG 2

standard cell voltage. Our standard is going to be a flashlight cell. As far back as 1927 I learned that these cells have an open circuit voltage of 1.555 volts and since our improvised potentiometer bridge will draw no current from our flashlight cell we are assured of a constant 1.555 volts. Because I do have both the L&N potentiometer bridge and a standard cell that is certified at 1.0192 volts I have checked my 1927 observation and find that flashlight cells still have an open circuit voltage of 1.555 volts.

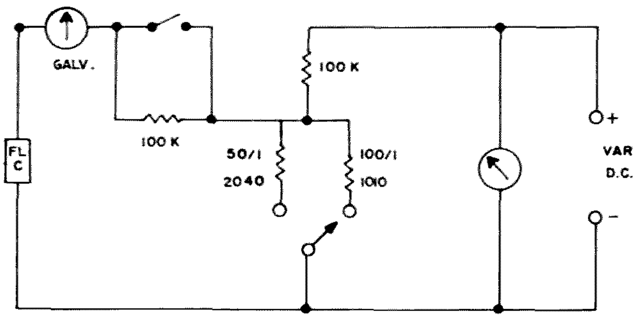


FIG. 3

Let's now look at Fig. 2. Here we have the ten 10000 ohm and the 1010 as well as the 2040 ohm resistors all connected up, together with a variable dc voltage source, a 25-0-25 microammeter, a push switch, a flashlight cell and a meter to be tested or a milliammeter to be turned into a voltmeter. The 100000 ohm resistor in series with the flashlight cell and the microameter is required to keep current through the meter within limits during changes of the variable dc voltage. When near balance has been obtained, the push switch shorts out the 100000 ohm resistor and final careful adjustment of the dc voltage is made to the point where the microameter reads zero. At this point the voltage across the voltmeter under test should read the 1.555 volts times the resistor ratio that was previously set up. The resistor stack has no bearing on the results of the test. It merely is a slight load across the dc source. Neither does the flashlight cell have any effect since it draws no current from the resistor stack.

You can do away with the resistor stack and use only 1 100000 ohm resistor and calculate the resistor to be connected at the bottom end of it and to the flashlight cell. You merely multiply the 100000 ohm resistor by the ratio you want to achieve and divide the result by the ratio less one. The difference between 100000 ohms and answer you got is the resistor needed. If 100/1 is what you wanted, the resistor value is the 1010 ohms mentioned above. The connections are as shown in Fig. 3. Now you know 'how to get it.' Have fun. . . . K6BJ

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Tuned Feeders Forever

When the writer started hamming almost thirty years ago, there were only a couple of really popular antennas. Our big favorites were the Windom ("single-wire off-center fed") and the tuned-feeder antennas—either end-fed (Zepp) or the center-fed system. A few of the boys were using exotic antennas such as the "delta-match" or some form of matched-impedance antenna using linear transformers for impedance matching. A few of the real old-timers were still using cage antennas and end-fed wires. I surveyed the situation and decided that the Zepp was my type of antenna. For several years I used tuned feeders—either the Zepp or center-fed antennas—with fairly good results. With either, I could flit around 80, 40, or 20 and load whatever rig was in use at the time without any worry as to how well the antenna was matched. The rig loaded and I got out.

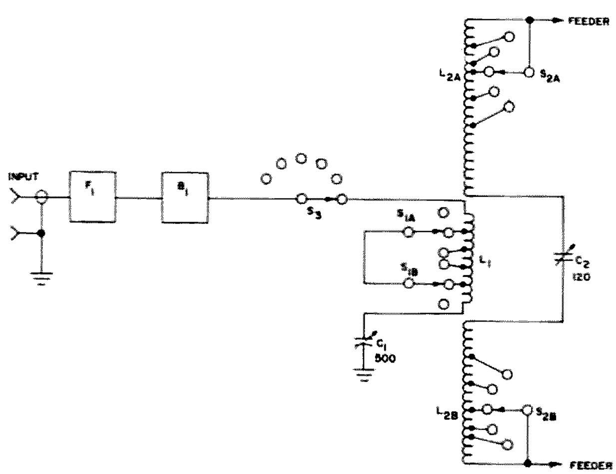


FIG. 1

F-1—Bud Low-Pass Filter.
B-1—Monimatch (See Ref. 2).
C-1—500 mmfd variable, .03-inch spacing.
C-2—120 mmfd variable, .077-inch spacing.
L_1, L_2 —Formed from one 7¾" length of B&W 3905-1 coil stock. L_1 12 turns in center, tapped at second and fourth turns from center on each side. L_2 separated by one removed turn on each side from L_1. L_2 tapped at second, fourth, eighth, fourteenth, and nineteenth turns from inside on each side.
S_1—Communications Products Co. Model 86 switch.
S_2—Communications Products Co. Model 86 switch.
S_3—BC-375 switch (See text).

Sometime in there I went to college and started learning about impedance matching. However, even the best-matched antennas got no more DX than the tuned-feeder jobs. Unfortunately, I found that with each improvement in matching, the frequency flexibility decreased. Coaxial cable came in there sometime. My big experience with pre-WWII coaxial cable happened in a B.C. station that had changed over from a cage to a coaxially-fed vertical. After the copper cable had flashed over a few times—with very expensive results—the Chief Engineer switched back to open-wire feeders. He claimed they were matched-impedance, but they looked like Zepp feeders to me. I gave up fancy feedlines and went back to tuned feeders forever—I thought.

Then World War II came along. With a little more schooling I became convinced that anyone who used tuned feeders had to be a dolt. The solid coaxial cables were introduced. When the war ended I was in Hawaii with a KW and a lot of surplus cable. I tried the coax with fair results, but found I wasn't getting out much better than other local hams who were using tuned feeders. This cast some doubts on the value of my education. However, about that time I acquired a bride who had some question about the aesthetic value of "wire ladders", and abortive experiments with rezepping were abandoned.

RG-8/U and I reached a moderately happy compromise over a number of years. I tried verticals with L-matches and inverted L-matches. In New Mexico my double-domed friends introduced me to various exotic forms of T-matches. I tried multi-wire coaxially fed dipoles and trap dipoles. Every one of those gadgets reduced my frequency flexibility and decreased my ability to switch from fone to CW frequencies to meet old friends.

In 1960 I rebelled. My inverted-Vee, multi-wire, coaxially-fed dipole was cut for 3600 kc and 7050 kc. I was unable to work old friends in the phone frequencies on those bands without operating on the antenna to the point where I could not operate in my

beloved CW contests. (I had become further echnically advanced and was using pi-L finals that spat with an SWR beyond 2:1.)

So, back to tuned feeders. The only decision o make was whether to use Zepp feeders or a enter-fed system. Geography and sad experience with inverted Vees determined the anwer. First, the wire had to be horizontal. The 75-foot tower supporting my tri-bander beam as roughly in the middle of a pathetically nadequate city lot. One friendly neighbor ad an even friendlier 60-foot tree about 150 eet away. No other trees in the neighborood would do as supports, and erection of ther towers was out of the question.

The antenna became a Zepp strung from he 62-foot level of the tower to the top of the tree. Counterweights on the tower—plus rope tretch—compensate for the sway of the tree. For added insurance, the rope holding the antenna is only quarter-inch manila. It has been proven satisfactorily that this snaps before the tower does.

The next problem was determining the length of the feeders. Back in the dim past we argued about whether to use multiples of quarter-wavelengths or half-wavelengths to cut the feeders for best results. Rufus Turner settled that. He proved that the best feeder length was that which stretched from the antenna to the shack. He also proved that the length of the "flat-top" was not particularly critical.[1] I used his recommended feeder length—down the tower, across the roof, down the side of the house, in the basement window, to the antenna tuner. It looks like 90 feet or so. The flat-top was cut at 135 feet.

The next problem was how to couple the feedline to the rig in such a manner that the rig looked into an SWR of 2:1 or less. For several years, the literature has been telling us that "antenna tuners" can be used to reduce the apparent SWR seen by the rig to 1:1. This seemed improbable. I built "tuners" for both 80 and 40 with all sorts of reactance-cancelling arrangements. To my great surprise, the apparent SWR could be adjusted to 1:1 anywhere in either band. Unfortuntely, the arrangement was bulky and inconvenient for band changing. A friend had a Johnson KW Matchbox. This did everything my set-up did nd did it more conveniently. My children's ravenous appetites precluded my purchasing one, so I started researching for an adequate substitute. (This is also known as reading all

[1] Rufus P. Turner, "Debunking Tuned 'Feeders' and the Exact Length' Mania," R/9, June, 1935, p. 7. (It is fortunate that this article is not generally available. Perhaps some enterprising editor could arrange a reprint.)

the back issues of the ham magazine.) The tuner had to be bandswitching, preferably from 80 through 10; it had to be capable of handling a legal kilowatt on CW and SSB; and it had to present a reasonably resistive 50-ohm load to the final. No truly satisfactory coupler could be found. One that came fairly close was discovered.[2] It had several faults: it was not a "front-panel" bandswitching gadget; the power handling capacity was too low; and it required switching from parallel to series tuning, which seemed a needless nuisance.

After a few days of thought, the need for switching from parallel to series tuning was eliminated. If enough inductance were put in series with each leg of the line, series tuning could be used on all bands. High power components and switches could be used. So, the tuner in Fig. 1 was built. To my great surprise, it worked. Several hours were spent in getting the correct combination of taps for each band. Best efficiency will be obtained with as few turns as can be used in L_2. This will vary widely with feeder length, but the coil lengths given should permit resonance with virtually any feeder length. In my case, the full length of L_1 was used on 80, the first taps on 40 and 20, and the second taps on 15 and 10.

I subsequently put one of the single pole, six-position switches from the BC-375 in at S_3, and use it to switch to other antennas, increasing the versatility of the coupler.

The Zepp and coupler have been in use for over four years. On 80 and 40, the comparison antenna is a 63-foot vertical, beautifully matched and well-grounded. (Two days of work and 1500 feet of copper, plus assorted water pipes, fence posts, ground rods, etc.) The Zepp is 10-to-20 db better on U. S. contacts than the vertical on either band. On DX contacts, the Zepp is better than the vertical on 80 by about 3 db, but the vertical has the edge on 40 by 4-to-6 db. On 20, 15, and 10, the comparison antenna is a three-element tri-bander at 75 feet. The Zepp is about 10 db below the beam in most directions—which accords with theory—and is used frequently when conditions are good for general work, and in contests when it becomes a nuisance to swing the beam.

The tuner enables me to tune to any frequency in the 80-through-10 meter bands. An SWR of 1:1 is obtained anywhere within the bands. Bandswitching the tuner takes only a few seconds. The tuner takes the output of a 4-1000A grounded-grid linear running at 900 watts on CW and 2Kw PEP on SSB.

All in all, the Zepp with its tuner makes a satisfactory antenna setup. I would change several things if I could. If my lot were large enough, I would put up a center-fed system, as it makes for better feeder balance. (Still, a little feeder radiation doesn't hurt. The real object of antennas is radiation, and I would prefer feeder radiation to feeder absorption.) I would also use the Johnson KW Matchbox, were it not for the aforementioned appetites. I would also like to live on top of a rotating hill. In the meantime, the Zepp makes a good compromise.

. . . W5DWT

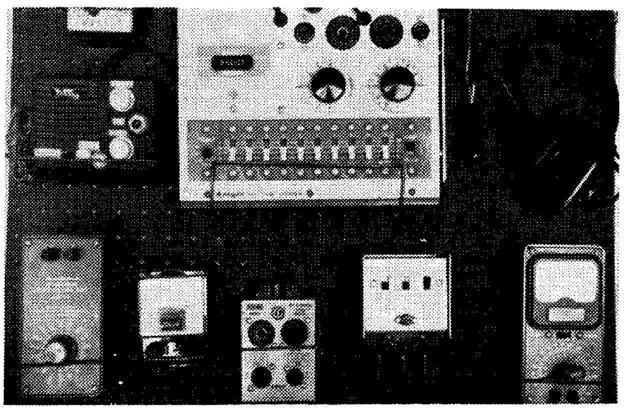
[2] The Radio Amateurs Handbook, 37th edition (1960), pp. 352-354.

Fred Blechman K6UGT

Pegboard Panacea

The use of "pegboard" in workshops and stores is certainly nothing new. It has been used for years to display small items of equipment and tools. However, the limitation on its more extensive use has been the availability of special "holders" for odd-shaped equipment; if available, the special brackets are expensive.

The home experimenter can eliminate this problem by simply using common coat hangers and a small tool!



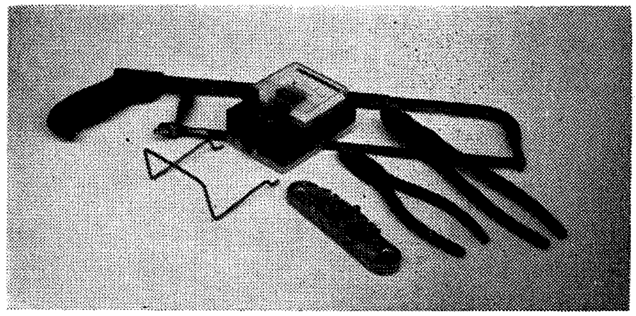
Even a small tube tester, such as the Knight "400," can be mounted out-of-the-way, yet accessible, on a pegboard. Coat hanger wire is surprisingly strong, yet easily formed and cut.

The tool, known as the "Handi-Bender", is sold by Jon-Cee Products Company, 1203 Ford Road, Cleveland, Ohio for 98c postpaid. This cast aluminum bending jig, with its slots and movable dowel pins, allows one to easily form wire into the sometimes-intricate shapes required to hold odd items of equipment to pegboard. A hacksaw or pair of diagonal cutters may be used to cut the wire at the desired points.

The coat-hanger wire is untwisted at its junction and straightened, using the slots in the Handi-Bender. One end is cut to remove the twisted portion, and a joggle is put on this end, using the dowels in the Handi-Bender.

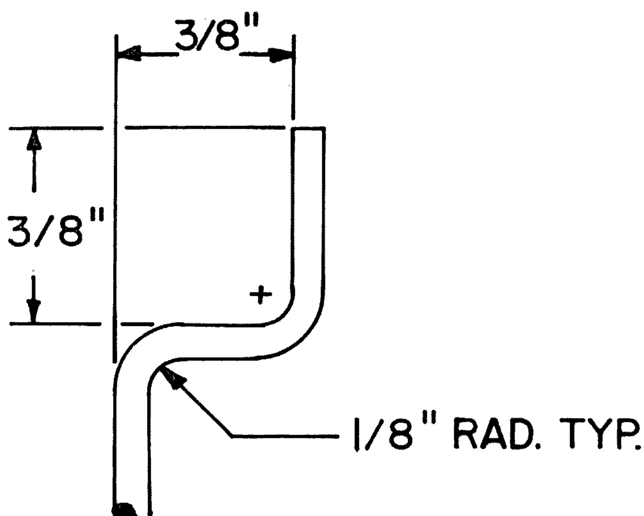
The dimensions of the joggle are not critical, but a joggle *is* required to keep the bracket from pulling out of the pegboard holes. The remainder of the bracket is then formed to accommodate the required equipment shape, ending with another joggle.

One 2 × 4 foot piece of pegboard will provide instant access to a surprising number of



The only tools needed to form the special brackets are a hacksaw and the "Handi-Bender," with an assist from pliers and diagonal cutters. The small meter is a natural for peagboard with the special coat hanger bracket shown.

small items of equipment that otherwise tend to get mislaid, and valuable bench and shelf space is saved.



JOGGLE DIMENSIONS (NOT TO SCALE)

The author has yet to encounter a reasonably small piece of equipment which couldn't be mounted in this manner, including a not-so-small tube tester, as shown in the photos.

. . . K6UGT

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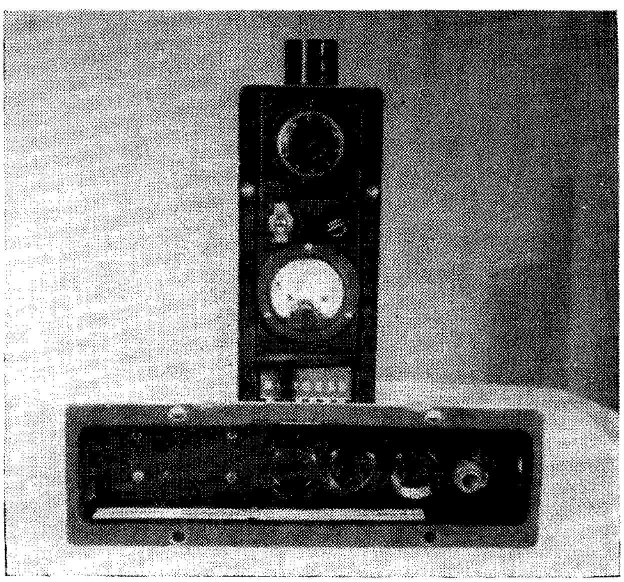
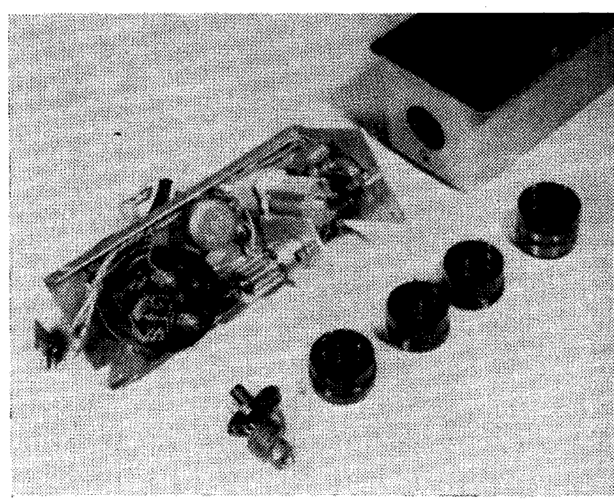
Low Cost Grid Dipper

Here is an item that can be used by all amateurs. How many times have you wound a coil for your new transmitter, on some odd size form, and wondered just how close you were to guessing the right number of turns. With the grid dipper you can measure the resonant frequency before you solder the coil and condenser combination into your transmitter permanently. A grid dipper has many uses. Among other things, it can be used to check resonant frequencies of antennas, including mobile whips. It can be used to measure relative field strength. It can be used as an emergency signal generator for communication receivers. I have even used it to align the *if* stages of my television set.



Construction: This particular grid dipper has a frequency range of 1.8 to 54.0 megacycles. It is battery powered, which makes it completely portable. It is built in a surplus tuning unit case from an RU-16 aircraft receiver. The parts are available from most junk boxes. Construction details are left pretty much to the reader as each individual will probably have some "pet" case he wants to build it in. A few suggestions are offered. Use a good calibrated dial. Use good quality bypass condensers. Ground them both to a common point, preferably on the rotor lug of the tuning condenser. Keep the leads to the coil socket short—if you intend to wind coils for 50 mc or above. The grid winding of each coil should be the top coil, with the feedback or plate winding near the base. Proper phasing of the coils is necessary to sustain oscillations. The grid and plate connections should be on opposite ends of the coil, with the ground and B plus near the center of the coils. For the 50 mc coil use a polystyrene base or mica filled base from some tube such as a 5R4 or 811. The 50 mc coil is self supporting and wound with #12 bare wire. Its feedback winding was wound with insulated wire and cemented with model airplane cement. The spare coils are stored in sockets, mounted in the cover of the tuning unit case. Any 0-500 ua or 0-1 ma meter will work. Battery leads may be soldered on if you have no battery connectors.



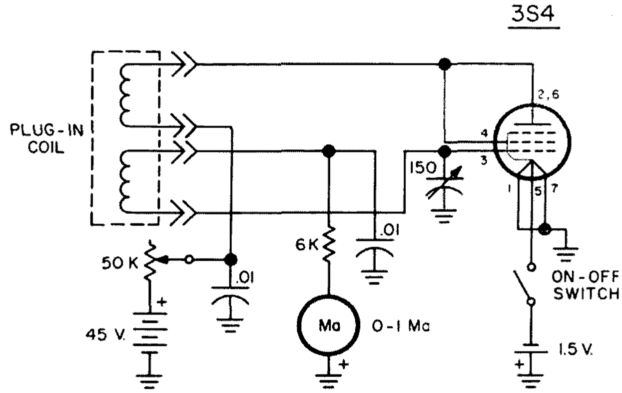
Calibration: Calibration is done by first setting your general coverage receiver to the calibration frequencies desired and then tuning the grid dipper until a beat note is heard.

I suggest that you calibrate it every 100 kc from 1.8 mc to 7.5 mc and then calibrate every 500 kc from there on, except return to 100 kc points through each ham band. I calibrated the higher bands on a Hallicrafter S-27 which covers 28 to 140 mc.

Using the Instrument: For ordinary tank coils, couple the grid dipper to the tuned circuit and turn the grid dipper dial until there is a pronounced dip in the grid current meter. This indicates resonance, and is due to the fact that some of the power from the grid dipper is being absorbed by the external tank. For the most accurate measurements, back off the grid dipper until only a perceptable dip is noticed. For high frequency slug tuned coils that utilize stray capacities to resonate them, the same method is used—but be sure that all the tubes are in their sockets. You may wish to set the grid dipper on a certain frequency and then tune the slug being measured until you notice a dip in grid current. If any coil is inaccessible due to its being behind a transformer or other shield, you can wind a one turn link around the grid dipper coil and another 2 turn link to fit over the other coil. Keep the link near the "cold" end of the coils.

Long Wire Antennas: To check resonant frequencies of long wire antennas, you can loop 3 or 4 turns of the antenna wire around the coil and tune for a dip. For extreme accuracy, check the frequency with your communication receiver, at the frequency of the dip, since attaching turns near the grid dipper coil will shift the frequency somewhat. In the case of an end fed antenna the frequency measured will be the ½ wave frequency. You can also connect the end of the antenna to a 2 turn link and ground the other side of the link. In this case the measurement will be the ¼ wave frequency. For instance, a wire 120′ long connected through a link to ground will indicate resonance at around 2 mc. Without the ground it will indicate resonance around 4 mc.

Mobile and Coaxial Feeds: Couple to the coax cable with a 2 turn link. Caution is advised when connecting to a coaxial cable.



COIL DATA

FREQ. RANGE	GRID COIL	PLATE COIL	SIZE FORM
1.8 - 4.3 mc	33 T #31	20 T #31	6L6 tube base
3.4 - 7.2 mc	17 T #19	10 T #31	6V6GT tube base
7 - 15 mc	7 T #19	6 T #31	6V6GT tube base
15 - 31 mc	3 T #19	3 T #31	6V6GT tube base
28 - 54 mc	5 T #12	4 T #18	3/8" diam. self-supporting

There are resonant frequencies within the cable itself, and if you start to change taps on your mobile whip and the frequency doesn't appear to be moving, you are probably checking a resonant point within the cable. For instance, a 12′ piece of RG8/U, commonly used with a mobile whip, will tune between 4.5 mc and 5.5 mc. Pruning of the loading coil will not affect this resonant point. The correct antenna frequency can be checked by holding your arm within a foot of the loading coil. A change in resonance would be noted.

Field Strength: This is done by backing off on the plate potentiometer until a minimum reading is obtained. Any signal picked up from a radiating antenna will be rectified in the grid circuit and the meter will rise to a higher value. In this manner you can also check for transmitter harmonics.

Signal Generator: To peak up the rf stages in your communication receiver, or converters, set the grid dipper several feet away and tune the receiver, with the antenna connected in a normal fashion, to obtain a maximum S-meter reading. Move the grid dipper far enough away to obtain an S4 to S7 reading. Trim the antenna and rf stages for a maximum S-meter reading.

. . . W7CJB

Transistor Amplifier Design The Simple Way

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It appears to be a safe prediction that transistors are here to stay. In fact, they might even be said to offer a few minor advantages over vacuum tubes from time to time. For example, how many times can a tube be dropped five feet to a concrete floor without damage?

But, as most amateur designers who have ventured into the semiconductor realm have discovered, transistors have one major disadvantage. It appears to be necessary to have at least six years' training in enginering and mathematics to be able to design a simple, ordinary, everyday class A amplifier using transistors!

At least, this is the impression gained when opening any transistor manual, even those directed at the hobby-level experimenters!

About the only way yet offered to sidestep this disadvantage has been the suggestion that a "test set" be built up to determine all parts values by trial and error. Use of such a test set requires an oscilloscope at least, and in addition is just too much trouble for many of us.

The reader who's been active in electronics for very long is undoubtedly familiar with at least a few of Murphy's famous Laws of Electronics; the most quoted is the First Law: "If anything can go wrong, it will." Not so widely quoted, but equally true in 99.999% of all known cases, is the Fifth Law: "If it's simple, it's wrong."

But the special case of transistor amplifier design is in that thousandth of one percent of cases when Murphy's Fifth Law fails; a simple way exists, and it's a right way.

This isn't to say that it can't be improved upon, but it will always yield a design which is as accurate as most tube-type designs taken from tube-manual data, and which cannot harm the transistor. Other simple methods exist, but they have no such built-in safety features.

Before we get into the simple technique involved, let's take a brief refresher look at the typical transistor amplifier, diagrammed in Fig. 1. As you can see, it consists basically of merely the transistor, a load resistor, and some bias-voltage sources. In the common-emitter circuit, most widely used of the three possible configurations for a number of reasons, the emitter is considered as the reference terminal of the transistor. Input signal is applied between base and emitter, and amplified output is taken off from the load resistor, which is effectively between collector and emitter since the bias supplies are assumed to have zero internal impedance to the signals.

Fig. 2 shows the original way in which the voltages were supplied. Separate batteries were used. To obtain proper transistor action, the collector must be reverse-biased with respect to the emitter, while the base-emitter junction must be forward biased. Fig. 2 shows proper battery polarity to meet these conditions for a pnp transistor; with an npn, all polarities must be reversed.

Though this was the original technique, it offers no protection at all against unavoidable variations between transistors of the same type, or even against variations of characteristics in the same transistor as temperature changes.

In addition, the two-battery requirement was unattractive. Early experimenters quickly figured out that one battery could be used by slight modification of the circuit, and the hookup shown in Fig. 3 was the result. This is still probably the most widely used transistor-amplifier circuit, but like the original circuit it provides no protection against variation of characteristics.

As a result, in such circuits Rb is usually made adjustable, and somewhere in the line-up instructions you'll find something to the effect of "Adjust base resistance as necessary to obtain proper operation." This isn't what you'd call the best in design.

Addition of two more resistors and a capacitor, as shown in Fig. 4, provides virtually complete protection against all variations, and this circuit is today the basic transistor amplifier circuit used in most commercial and military apparatus. Unfortunately, almost all the handbooks bristle with complicated mathematical formulas when they discuss proper choice of resistor values for the circuit, and as a result most of us steer clear of using it.

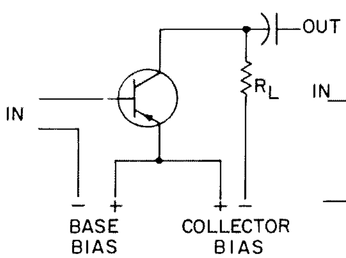

FIG. I

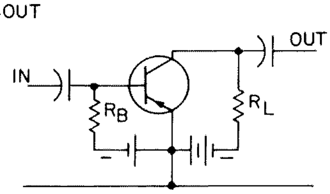

FIG. 2

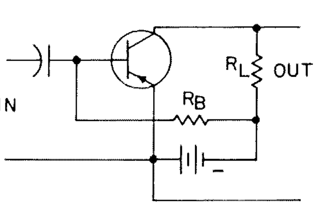

FIG. 3

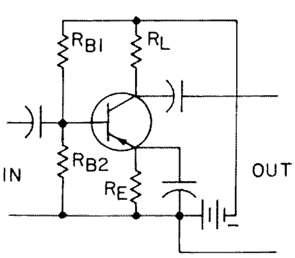

FIG. 4

The unfortunate thing is that all the complication isn't necessary unless you're designing the circuit to meet rigid commercial or military specifications. For general use, a far simpler technique yields almost identical results. While a little arithmetic is involved, most of it is nothing more than the use of Ohm's Law, and the rest isn't any more complicated.

The procedure works this way: first, pick your transistor type. Decide what supply voltage you're going to use (9-volt battery, 20-volt line, or what have you?). Pick a collector-to-emitter voltage somewhat smaller than the supply voltage, and an operating-point current which will be the final current read on a milliammeter inserted at point X in Fig. 4.

For best results, the supply voltage should be about three times the collector-to-emitter voltage to be used, but any voltage more than twice the V_{ce} is usable. Select a value for the collector load resistor, R1, so that the voltage drop across it at the operating current will be approximately equal to the drop across the transistor itself; if V_{ce} is to be 5 volts, and current is to be 1 ma, then R1 should be 5/.001 or 5K ohms.

Add the drop across R1 to the chosen V_{ce}, and subtract the total from the supply voltage. This tells you how many volts must be dropped across the emitter resistor, Re. With a 12-volt supply for our preceding example, and a 5100-ohm resistor for R1 (to use standard values), Re would be called upon to drop 1.9 volts at 1 ma, so would have to be 1900 ohms. Either 1800 or 2000 ohms would be usable.

To get the values for the base-bias divider,

we apply a rule of thumb which is sufficiently accurate for all practical purposes: in a properly operating transistor amplifier using a germanium transistor, the base voltage will be ¼ volt away from the emitter voltage, and in the same direction as the collector. That is, for a pnp transistor, the base will be ¼ volt more negative than the emitter. (With silicon transistors, the figure is 7/10 volt).

This means that the base-bias voltage divider must be proportioned so that the base voltage will be ¼ volt way from the emitter voltage. In our example, the emitter resistor drops 1.9 volts, so the lower leg of the base divider, R_{b2}, would have to drop 1.9 + .25 or 2.15 volts. If we assume 1 ma of current is to flow through the divider, this would require a 2150-ohm resistor, and a 2200-ohm standard value would suffice.

The other base resistor, R_{b1}, must drop the rest of the supply voltage at the divider current; to continue the example, R_{b1} would be required to drop 9.85 volts. At 1 ma, this would be 9,850 ohms. A standard-value resistor would be either 9100 ohms or 10K.

Actually, 1 ma of divider current is far more than necessary. A value of 100 microamperes is usually more than necessary and provides ample safety margin. This allows all divider-resistor values to be increased by a factor of 10, giving us 22K and 91K or 100K as end values.

In both cases where the calculated value has fallen between two standard values, we have indicated that *either* standard value may be used. This is true because the entire circuit is highly self-regulating, and corrects for these "minor" errors rather closely.

To see how this works, let's draw up our example in Fig. 5 with the calculated values, then check back to see how the standard values affect the result.

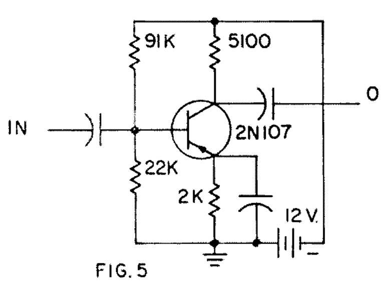

FIG. 5

With Re equal to 1800 ohms, using a 91K resistor for Rb1 gives a resulting collector current of 1.17 ma; if 100K is used at Rb1, current drops only 120 microamps to 1.05 ma. With a 2K emitter resistor, the 91K resistor in the base divider gives 1.05 ma collector current and the 100K resistor gives 0.95 ma.

Our design target was 1 ma exactly; the use of values other than the exact ones calculated has caused a maximum error of only 170 microamps in the current, and two of the combinations are only 50 microamps away from target.

Here's how to check it, so that you can use the same approach to check out your own designs: First, determine the voltage present at the midpoint of the base-bias divider. Subtract ¼ volt (or 7/10 volt for silicon) for the base-emitter drop, and the result is your emitter voltage. With emitter voltage known, the voltage across the emitter resistor is fixed. With this voltage and the value of the resistor known, current can be quickly determined by Ohm's Law, $I = E/R$.

You might notice that "beta" or the transistor's current-amplification factor does not enter into the calculations at all. This is not an oversight; a circuit designed by this approach will give virtually identical current flow regardless of the gain factors of the transistors plugged into it! This is, in itself, powerful protection against variations in characteristics. It also enables the experimenter to make direct comparisons of various models of transistors, to see which works better for his purposes.

To get an approximate idea of the gain to expect, another rule of thumb is often handy. This one says that the average gm of most transistors is about 0.4 mhos; while individual types vary in exact value, this is close enough to be of practical use with all the readily available ones. As usually used, a transistor is almost equivalent to a pentode tube, and so the pentode gain formula (gain = gm times R1) applies. The circuit of Fig. 5, therefore, could be expected to have a voltage gain of about 2,000. Its maximum output before clipping, however, is only 10 volts (twice the collector-emitter voltage) so that maximum input signal would be 5 millivolts. To allow larger input signals, the value of R1 can be reduced which in turn reduces the gain. Increasing the operating current can maintain the same voltage drop across R1 (halving the resistance while doubling the current maintains the voltage constant) which will, in turn, allow the same output voltage. Since gain has been cut in half, though, the input can now be doubled.

Following a similar approach will allow you to design a transistor amplifier for almost any application you may have in mind—and without need for any complicated math. With this ability safely in mind, you too may agree that semiconductors may be here to stay!

. . . K5JKX

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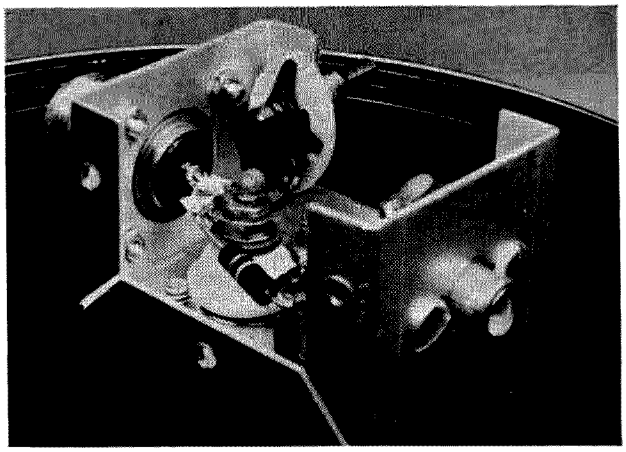

Photo Credit: Joe De Young WA6CQL

The Heath Cantenna is an excellent aid for ham experimenting. This simple modification extends its use to above 432 mc.

Modifying the Heath Cantenna for UHF

The first requirement for accurate rf power measurements is a flat dummy load. Likewise, very low vswr in a dummy load can be an important factor in testing high power transmitters.

Several relatively inexpensive dummy loads are currently available for 50 ohm lines. Of these, at least three are capable of handling up to a kw output.

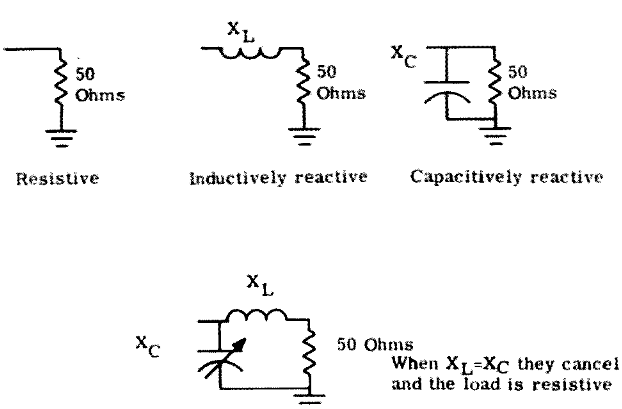

Fig. 1. A dummy load may appear resistive or reactive to rf. The Cantenna acts slightly inductive at UHF but addition of a small capacitor cancels this inductive reactance.

At high frequencies, these loads perform well and exhibit tolerable vswr. However, in the VHF and UHF frequency ranges, performance falls off due to a rising vswr.

The Heathkit Cantenna power rating is 200 watts continuous and 1000 watts for up to ten minutes. The vswr at 50 mc was measured at about 1.15/1. This is a generally acceptable level however; at 220 mc the vswr rises to 1.35/1 and at 432 mc the figure was 1.8/1.

A high power 432 rig operated into such a load might be seriously damaged if the transmission line were being operated near its ratings (an easy thing to do at 420 mc).

Mismatch in dummy loads is the result of either a resistive mismatch or a reactive component in the load.

Since the dc resistance of the load is 50 ohms the source of the standing waves at VHF is probably reactive. This reactance is generally either a shunt capacitance or a series inductance. See Fig. 1.

The source of this reactance is generally either a peculiarity of the load material itself or a lead length or dress problem. In practice, it is generally a combination of a lot of the former and some of the latter.

In theory, then, to return the load to a resistive impedance of 50 ohms, it will be necessary to cancel the reactive component by adding the proper value of either inductance or capacitance.

This generally means that load flatness becomes a frequency sensitive thing, i.e. the load is tuned or rather the reactance is tuned out. This is no more than what you had before, except that now the effect can be controlled.

In applying this theory to the Cantenna, it was found that in the 220-450 mc range, the load exhibited some series inductance. It was further found that, according to theory, a small capcitance shunted across the load could

be made to cancel the inductance in the load and produce a resistive 50 ohm situation at 432 mc and hence reduce the vswr to virtually 1/1.

This was done by adding a small variable air capacitor of 5 to 7 mmfd across the input to the load to ground.

The capacitor in the photograph had just enough capacity to null the standing waves at 432 mc.

The lowest vswr at 220 was observed at maximum capacity and, though lower than before, did not produce a null, indicating that more capacity would reduce the vswr even further than the value shown in Fig. 2.

It will be noted that a slight increase in vswr is seen at 50 mc with the capacitor installed at maximum capacity. This indicates that somewhere between 220 mc and 50 mc the natural reactance of the load has changed from inductive to capacitive.

FREQUENCY	VSWR NORMAL	VSWR WITH CAPACITOR
50 Mc	1.25:1	1.35 : 1
220 Mc	1.43:1	1.35 : 1
432 Mc	1.8 : 1	1 : 1

Fig. 2. VSWR measured at various frequencies with and without added capacitor. All measurements with capacitor are with capacitor fully meshed.

The general conclusions to be drawn from all this are: if operation is desired primarily at 50 mc, and the vswr must be below those given, a small amount of inductance between the connecter and the load terminal should flatten out the load; and, if operation is desired from some undefined point below 220 mc to some equally undefined point above 432 mc, a 10-15 mmfd air variable will allow the load to be tuned to minimum vswr.

If very low vswr operation is required from 50 mc to 450 mc, a small inductance and a 10-20 mmfd air variable might both be installed and allow the load to be tuned across the entire range.

Though these last statements are, for lack of confirming experiments, somewhat conjecture, the fact of a flat load at 432 mc and an improvement at 220 mc was definitely established, and though no figures are shown, tests indicate that these modifications have little, if any, detrimental effect on operation below 30 mc.

. . . K6MIO

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I'd Like to See:

The Three-way Two-stop. This much needed mechanical device for facilitating the "three-way" QSO is a simple built-in mechanism in the main tuning dial of the communications receiver. The dial looks normal except that it has two buttons on it. When you have tuned in Joe you push the button marked "A". Then when you tune in the party of the second part, you depress button "B". That's all there is to it. Returning to Joe is easy because the dial locks and will not turn farther south. And in the other direction, you cannot overshoot either. I forgot to say that there is also a red button which releases the two pre-set locks. Even my typewriter carriage does something like this.

The Blast-off. This is simply an avc circuit which really works under rugged circumstances. Suppose you have picked up a weak signal which just *must* be rare DX, so you advance the rf gain, the better to hear it. *Crash!* The fellow down the block—the one with the Texas Kilowatt lets go with a CQ. Of course the rare DX is gone forever, but you would like to salvage your headphones, your eardrums and your poise. Why not a real *avc*?

The Double-Out. Rejection tuning is a great thing. So why do they not give us *two* of them to reject interference and noise on *both* sides of the desired signal? So simple.

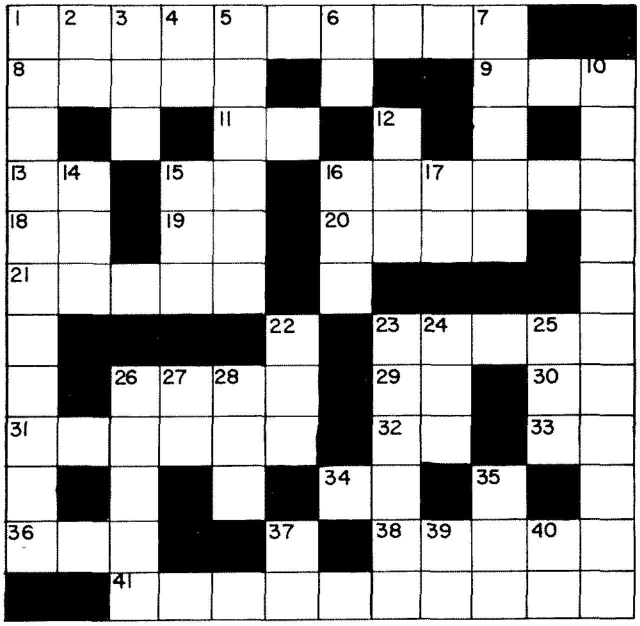
The Great Inflatable Kite. This remarkable invention is just the thing to take with you on Field Day. It rolls up and fits in a cigar box. Two large pieces of plastic sheeting, trimmed to "kite-shape" are edge-sealed together all around. Spot-ties hold the two surfaces together at suitable points. When inflated from your CO_2 cartridge (or with hydrogen!) it becomes a near-ideal airfoil. So carried away was I in flight of fancy that I almost forgot to mention that the director, reflector and driven element of shiny silver are cunningly plated on the inside surfaces of the plastic envelope. (The true exhibitionist ham will have his call letters in six-foot block letters on the under-belly.)

The Tab-Log. This modified Log Book is a great convenience to those organization hams who diligently keep an alphabetic card index of important contacts. In this case, the log book has a fold-under extension of the left-hand edges of its pages. Carbon paper is inserted of course; and the result is that when you have completed a page, you have a tear-off section which is a carbon copy of the important information on each contact—date, time, station called, etc. Of course the carbon copy is gummed, and the separate entries are perforated for tearing apart and pasting-up on the 3×5 index cards.

The Self-timed Tape Recorder. Tape recorders and accessories are being made more complex, yet more useful, by leaps and bounds. Yet the very obvious feature—a built-in start & stop timer—does not seem to appear. In our opinion, all excepting the lightest portable instruments should be so equipped. I need it to turn on and off the recording function when I am in the bowling alley (which I've never been in one of yet). Of course the aim is to engage in some purposeful eavesdropping on the bands *in absentia,* or merely to record a radio program after hitting the sack. It's obviously illegal to use such a timed recording as a shouter-outer on the bands if you're not in the shack yourself; however the on-off recording function would be very useful in many ways, such as monitoring your own mobile signal from the home station when you are on the road. On and off function switching will probably have to be power-actuated by solenoids to avoid flattening of the puck and drive discs. Come on, somebody, do something! . . . W2LLZ

Ham X-Word.

Harvey B. Rock, WA2BWQ



ACROSS

1—Power conversion device
8—type of wave
9—$\overline{SK}$
11—$4\pi^2f^2$
13—Final Amplifier
15—Defense agency
16—Antennas
18—Unit of energy
19—Transistor amplifier configuration
20—Transformer current
21—Type of silicon junction diode
23—keying fault
26—Fixed negative tube voltage
29—Argentina
30—See 13 Across
31—Function of second stage in some transmitters
32—Communication mode
33—That
34—Saint Martin
36—Descriptive of circuit containing inductance, capacitance and resistance.
38—Not neutralized; ____________scillation (2 words)
41—Type of transistor current.

DOWN

1—Scope pattern
2—Ham (abb.)
3—Address
4—Nickle (Chem.)
5—Make a connection
6—Georgia (Prefix)
7—Switching device
9—1/Q of a capacitor; ____________ factor
12—Heard
14—Avenue
15—Capacitance between collector and emitter of transistor
16—Government agencies
17—AC collector resistance of transistor
22—Please
23—Amplifier type (2 words)
24—Result of lack of filtering
25—Repeat
26—Rough spot on chassis
27—Type of transistor current
28—W4 state
35—Relay
37—RTTY part
39—Ethiopia
40—French Oceania

Answer on p. 81

Conelrad: NO!

Anthony "Tony" Curtis K3RXK
1333 Logan Blvd.
Altoona, Pennsylvania 16602

E.B.S.: YES!!

Recently, the civil defense authorities and the Federal Communications Commission struck down the emergency broadcasting system known as CONELRAD: CONtrol of ELectromagnetic RADiation. The old system which had been under fire from some sources for some time was called inefficient and too complicated for its value. In the void, the FCC created a new network for commercial broadcasting radio and television stations to use for emergencies. The new system is known as EBS or Emergency Broadcast System.

A great many people around the country have been mystified by the system because, as yet, the civil defense authorities have not heavily publicized the new procedures. Actually, the main difference between the new EBS and CONELRAD is the fact that after stations are notified to leave the air due to some natural or man-made emergency, those authorized to return to the air with emergency broadcasts will do so on their original transmitting frequencies. This is to be compared to the old system of permitting some stations to return to the air on **640** kc and **1240** kc. There are other differences but this is the most striking change in plans.

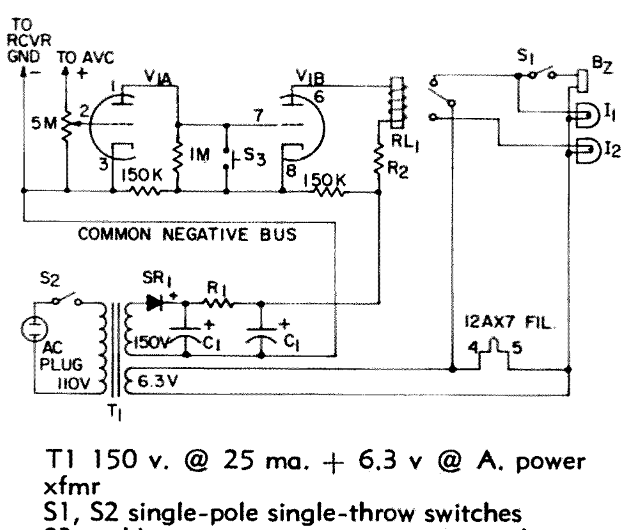
So, you say: How does this affect me? Well, the answer is simple. Even though the individual amateur is no longer required to constantly monitor his local station for program interruptions, it is still of very great value to the ham to know just when his local station goes off the air.

If the Big War comes, we will want to be warned just as soon as we possibly can be. Some system to unobtrusively watch for such notification would be most desirable. Any sudden floods, hurricane, tornado, or other natural disaster striking your area should be acknowledged immediately. A source of immediate notification in this event would be very handy, indeed. If a system of EBS monitoring could be available inexpensively and conveniently, there would be no need for any ham to be caught unaware.

CONELRAD operation experience by manufacturers, electricians and broadcast station engineers has contributed greatly to the art of emergency notification signal pickup. Many systems have been devised which are highly successful. This article will describe one simple system which is minor in cost of construction and cost of operation. Construction time is slight and operation of the unit is not a headache to those persons who have to bear the unit daily.

The unit is powered by its own internal power source or it can rob power from the host BC rcvr which supplies avc voltage. A single dual-triode 12AX7 is used to interpret the broadcast signal (or lack of signal) and to trigger the alarm relay at the time when the station goes off the air. Switch S3 is a reset button which returns the unit to its ready-to-go position of operation.

The alarm system is fired by the relay and



T1 150 v. @ 25 ma. + 6.3 v @ A. power xfmr
S1, S2 single-pole single-throw switches
S3 pushbutton momentary contact switch
Sr1 20 ma. selenium rectifier
R11 5000 ohm coil relay
R1 1000 ohm/1 watt
R2 1000 ohm
R6 5 megohm potentiometer
C1 16 mfd. @ 250 v. double-section condensor
V1 12AX7 tube
Bz 6 v. buzzer
I 1, I2 red and green pilot lamps

the alarm itself can be anything from an electronic tone to a light bulb. Each person can custom design the unit for his own setup. I chose to use a small 6 volt buzzer and red-glow pilot lamp for alarm, with a green-glow lamp used to indicate that the unit is on and in the ready-to-go position. Using an SPDT relay allows a system similar to this, but you might choose to use the simpler and cheaper SPST relay, which would permit an indication only at alert time.

Whether your host receiver has 6 or 12 volts available for filaments, you can still use the 12AX7 tube.

A great many transistor radio sets are in use today, causing many of the older tube sets to be left here or there to collect dust. Any old set capable of supplying the necessary avc, would be suitable and could certainly be most easily found and obtained.

So, even though CONELRAD is out, EBS is in and we should all take it upon ourselves to make some definite arrangement to use this excellent emergency warning system. It may seem like a bother now, but if WW III comes you will be most happy to have all the extra seconds of the fifteen minute warning you can get!

. . . K3RXK

The what, why and how of ALC. Make your signal seem up to 20 db stronger.

Jim Kyle K5JKX
1236 N.E. 44th St.
Oklahoma City, Okla.

Automatic Load Control for SSB

One of the most useful, though least discussed, operating aids for the sidebander is the device known as "automatic load control." An ALC-equipped transmitter cannot flat-top, is unable to produce splatter unless woefully mistuned, and in addition will be some 6 to 20 db louder at the other end of the line—and yet the standard ham handbooks, all together, devote less than half a page to the idea.

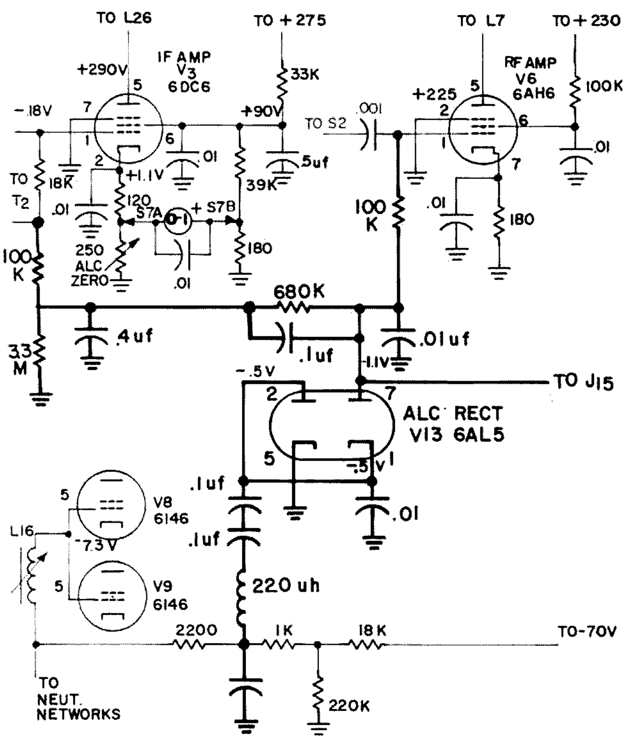


Fig. 2 ALC circuitry of Collins 32S-1

This might be comprehensible were ALC a difficult idea or if it were complicated to add to an existing rig. But the fact of the matter is that ALC can be added to any transmitter in which the final operates Class AB1 in a matter of minutes, with junkbox parts.

If you're among the gang using a 100-watt-range exciter followed by a big linear, you can make the ALC work with both. Alternatively, you can put the ALC in only the exciter, then swamp it down so that it cannot overdrive the linear. You'll still have the same advantages.

Before we get into the "how" of ALC though, let's take a look at what it is and how it works.

The "what" is simple. It's a fully automatic system which "rides the gain" on your exciter's drivers so that the final is never overdriven. Accomplishing this simple end does away with most types of SSB distortion. In addition, you can then crank the audio gain way on up, since the peaks will never be able to overdrive the output, and you now have the equivalent of an audio compressor. This raises the average-to-peak power ratio of the voice, just as the land-line folks do with compandors or the AM gang with speech clippers, and increases the "loudness" of your signal at the other end of the circuit.

The "how" is equally simple but at this stage several alternative approaches are available. The first one tried consisted of a gadget to pick off a little of the outgoing energy at the antenna connector, rectify it to get negative-going dc, and apply this dc (after filter-

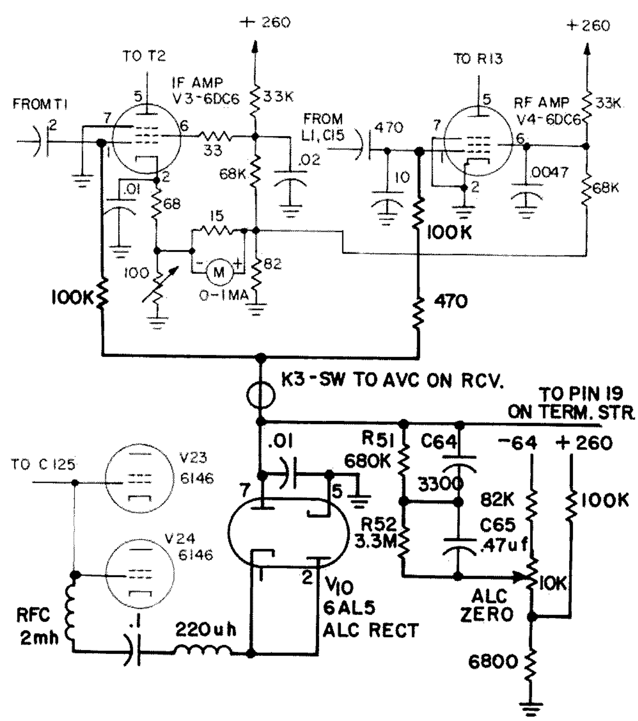


Fig. 1 ALC circuitry of Collins KWM-1 (Switches omitted, connections drawn as they exist when S4 set to SSB and S2 to ALC, unit in transmitting condition.)

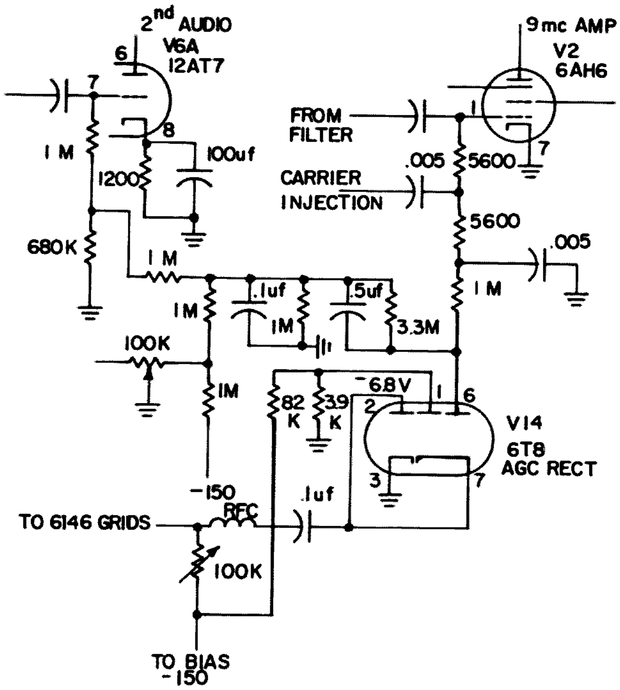


Fig. 3 Johnson Invader ALC circuits (simplified, switching omitted)

ing out the af hash) to a low-level driver stage just as avc is applied in a receiver to cut back the gain.

To make this system work, it's necessary to put some delay bias on the rectifier so that the final can develop full rated output before the ALC starts to cut down gain. This complicates things a bit, and in addition the gain reduction is slower than most of us would like.

However, it's used by Hammarlund the HX-50, and appears to work nicely there.

But the fellows at Collins came up with a much simpler idea which applies to all Class AB1 finals. They remembered that the grid-leak AM detector of earlier days was simply a diode detector made up of the grid and cathode of a tube, direct-coupled to an amplifier (the same tube). The essential part of this memory was that grid and cathode form a detector.

They do the same thing in an over-driven AB1 linear. The detected signal shows up on the grid-bias line as hash at audio frequency.

If you just insert a reasonably high impedance (to audio) in grid-return line, then pick off the audio through an rf choke to eliminate the rf and a series capacitor to get rid of the dc, you can then rectify the hash to get a control voltage.

This voltage will be completely absent until the final is driven into grid current. The instant grid current begins to flow, however, the control voltage appears. When properly applied to driver stages, the effect is to keep the tube operating right at the grid-current point all of the time. This does no harm, and assures you of maximum power out.

Fig. 1 shows how it's done on the KWM-1, with the ALC circuitry presented in bold lines. V10, a 6AL5, rectifies the hash, while R51, R52, C64, and C65 form a combination filtering and hang-time circuit. The two capacitors charge up instantly when control voltage appears, but take nearly 1½ seconds to discharge, so that the ALC voltage follows the average level but is never lower than any occasional peak.

The sole earlier description of this circuit incorrectly refers to V10 as a voltage doubler. While it does look like a voltage doubler as used here, it is not. The 0.1-mfd input coupling capacitor never returns back to ground directly, so the charge on it is not used in getting the ALC voltage. The diode of pins 2 and 5 is a shunt rectifier, while that of pins 1 and 7 is a "hang" diode which prevents the rectifier or source resistance from affecting the time-constant network.

In the KWM-1, the control voltage is applied to *if* amplifier V3, and to rf amplifier V4, both 6DC6's. Each gets the same amount of ALC. The lead to pin 19 of the terminal strip is for applying external ALC from a separate linear, while the ALC-zero circuit is for zeroing of the meter (a modified S-meter circuit).

The circuit used in the 32S-1 is similar but not identical. In this one, the rf amplifier is a 6AH6 rather than a 6DC6, and it gets a larger share of the ALC voltage. However, the 6DC6 does most of the controlling and the rf amplifier's main contribution is protection against instantaneous high-energy peaks.

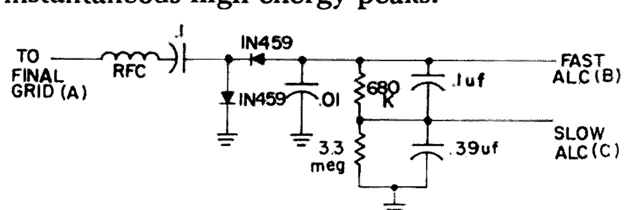


Fig. 4 ALC adapter for any AB1 final

We didn't redraw the KWM-2 circuit since it is so similar to that of the 32S1.

When used with the 30S-1 linear, ALC voltage is developed in the linear rather than the exciter. The grid return is made through an audio transformer, and the hash to be rectified is taken from the secondary of this transformer. No time-constant networks are employed, since they are in the circuit of the exciter at all times.

When using one of these exciters with the 30S-1, the ALC output of the linear is jumpered to the external ALC terminal of the

exciter, and the exciter is tuned so that its own ALC never gets a chance to operate (very light drive). Then the linear's ALC will act to keep the final fully driven as much of the time as possible.

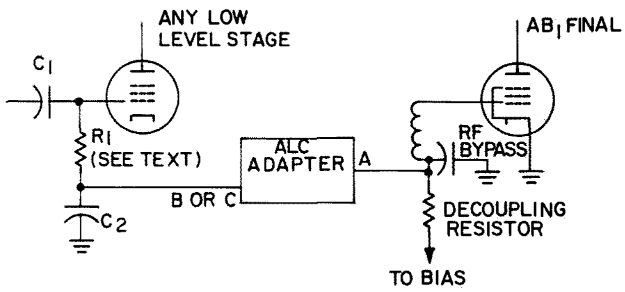


Fig. 5 Hookup of ALC adapter

Hammarlund and Collins aren't the only manufacturers using ALC. Johnson includes it in the Invader, and the circuit is shown here. It is similar to the Collins approach, except for the "clamping" voltage applied through pin 1 of the 6T8. This voltage prevents the ALC line from ever going more negative than about —7 volts. This is necessary, since the Invader controls the second audio stage as well as its 9-mc amplifier. ALC voltage on the 12AT7 must be kept to less than a couple of volts.

Heath includes a simple and effective ALC circuit in the HX-20, while Hallicrafters uses what they call AALC (amplified automatic load control) in the SR-150.

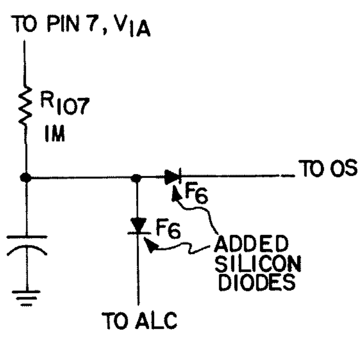


Fig. 6 HT-37 modification

The Hallicrafters circuit simply puts a triode amplifier between the grid-pickoff point and the diode rectifier, to give a more positive cutoff. They use half of a 6EA8, with a plate load resistor of 47K ohms and an unbypassed cathode resistor of 1000 ohms. The remainder of the circuit is "standard".

Along about now, some of you should be noticing that for the ALC to operate, the final grid *must* be drawing a small amount of current. Otherwise, there's no ALC voltage.

Worry not. Collins says that this minute amount of grid current actually helps improve linearity. While we might tend to quibble with that declaration, there's no doubt that the 30 microamps or so that flows with a good ALC working doesn't do anyone any harm.

So now to the "how." You real sharpies are probably already at the bench, adapting one of the Collins circuits. If not, Fig. 4 is a ready-adapted version for you. This can be assembled in five minutes or so with a mere handful of parts, and in fact will all fit on a single 5-terminal tie point which can be tucked into any odd corner of your rig.

Fig. 5 shows how to connect it into the rig. If the decoupling resistor isn't present in your grid return, add it. Don't use less than 5K ohms, for this is your gain control. The higher the value of this resistance, the more ALC you'll get for a given amount of grid current. R1, C1, and C2 may already be present in your rig. If not, use a .01 disc ceramic for C1, a 100K ½-watt for R1, and a .001 disc for C2. Hook to either B or C as you prefer. You'll probably want to try it both ways to see which works best for your own voice and equipment.

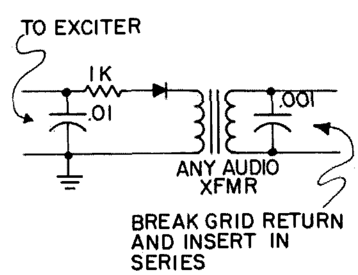


Fig. 7 ALC for any AB1 outboard linear

Picking the low-level stage to control should be little problem. In the Swan transceivers, the 6CB6 *if* stage is a natural. This requires only lifting the ground end of the 470-ohm resistor in its grid, and bypassing it. In the HT-32, connection can be made to pin 1 of V5. The HT-37 requires a bit more effort; details are shown in Fig. 6.

If you are running with a linear, the simple adapter of Fig. 4 may not quite fill the bill unless exciter output is swamped down so that maximum exciter output just barely drives the linear to saturation. However, the version shown in Fig. 7 will handle virtually any AB1 amplifier. This is an adaptation of the 30S-1 arrangement.

For the popular "four-811's" Class B linears, these simple circuits won't quite do it. One which should, based on the design used in the Collins 30L-1, appears in Fig. 8. Unlike the other circuits shown here, this particular one hasn't been performance tested and may possibly have a hidden bug or two. The time-con-

stant network is omitted deliberately, since it's assumed that the exciter will have its own ALC adapter installed for those occasions on which you want to use it barefoot.

The only thing to be careful of when installing the ALC adapters is not to foul up the rf circuits. Keep the lead from the grid-pickoff point to the rf choke as short as possible. Aside from this, almost nothing is critical.

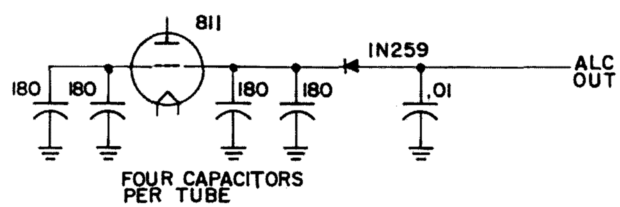


Fig. 8 Class B system

A few rigs may give you trouble in "tune-up" position after ALC is installed, since grid current developed during tune up procedures will try to swamp itself out through the ALC. This can be overcome by grounding the ALC line during "tune" operations, with a spare contact on the function switch of the rig or with an external switch or relay. The hookup appears in Fig. 9.

After installation of ALC, the rig will tune and operate as before. The only difference is that plate current will never rise higher than some value determined by the final tube and its operating conditions.

The mike gain knob now acts as a "compression" control. If left in its original setting, you will have approximately the same talk-power output as before and the only difference will be that you now have automatic splatter protection. However, if you twist the mike gain higher the talkpower will come right on up, and no splatter will be introduced. The signal will remain clean, regardless of mike gain control setting, until driver stages overload, and with commercial equipment of good design this just won't happen.

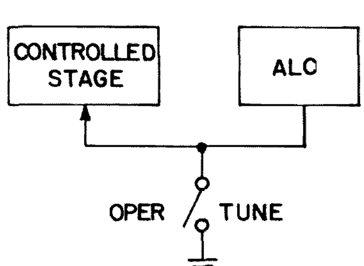


Fig. 9 Tune/oper switch

To determine if the ALC is actually doing anything, you can rig up a meter circuit following the leads given in Figs. 1 and 2, or you can measure ALC voltage directly with the metering circuit shown in Fig. 10. Zero reading on the meter indicates that the ALC is not in action. The greater the compression being provided, the higher the meter will read. If you like, you can calibrate the meter in decibels with the aid of an adjustable-output audio oscillator by first setting the oscillator so that the needle just barely lifts off zero, then doubling the oscillator output. The resulting needle position will indicate 6 db of compression. Doubling output again will provide the 12-db point. In-between calibrations should be more or less linear, since ALC voltage is a logarithmic function of signal input.

If you use the circuit of Fig. 10 and an 0-1 ma meter, you can adjust meter sensitivity with R2 so that it reads 0.3 ma at the 6-db-compression point and then read approximate db of compression directly from the scale, simply multiplying by 20. Thus a reading of 0.5 ma would be 10 db of compression.

In general, it's best to use from 6 to 10 db of compression for all-around purposes and save the rest for really digging deep after that elusive DX. With a single controlled stage, the useful range of control will be about 20 db, and with two controlled stages you can get twice as much. However, extreme compression leads to forms of audio distortion, as well as making all background noises seem to be just as loud as your voice.

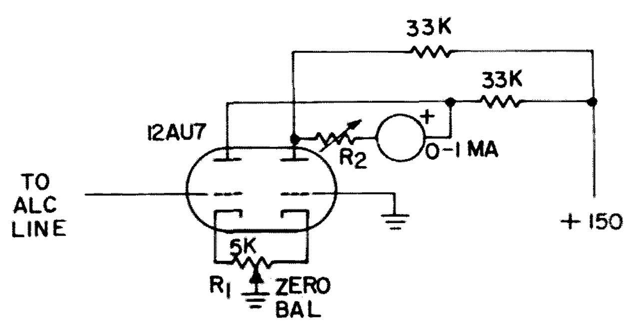


Fig. 10 ALC meter circuit

Normally, with articles such as this, we like to run a list of references for the fellows interested in additional homework. The list is short this time, though, since almost nothing has been written on ALC. Only three previous items could be found; one is in CQ's SSB column for April, 1961 (page 75), one is in Collins Radio's book "Fundamentals of Single Side Band" which is now out of print, and the lst is in W6SAI's huge Radio Handbook. So don't waste time reading any more; unbutton the bottom plate of the rig and get that ALC installed! You'll have a lot more fun, and so will the rest of the fellows on the band.

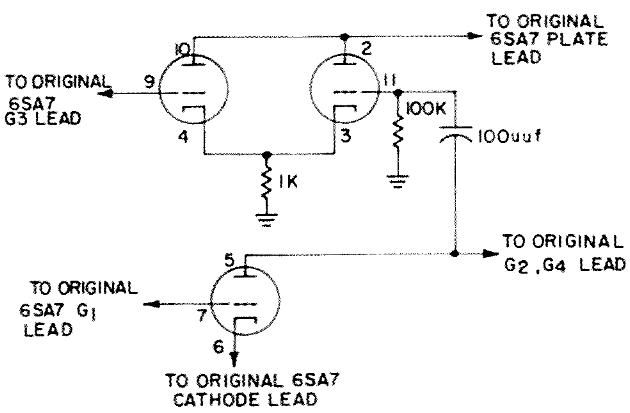
. . . K5JKX

John Reed K9ITR
RR2,
Pekin, Illinois

Front End Hint

The purpose of this article is not to sell you on the Like New Mixer, but to offer a few pointers concerning its use in receivers (such as my SX99) that use the old 6SA7 noise generator as a self-excited converter. Usually there is no room to mount a separate tube for the oscillator, and did you ever try to mount a 12AT7 in a 6SA7 hole? It can be done, but it is no snap. I ran into this when planning to change my SX99. Here is my solution to it.

The 6D10 Compactron is a three triode tube, with the same characteristics as the 12AT7. As an added attraction, you can remove the old octal socket and the new 12 pin socket will fit the same hole.



6D10 Mixer.

On the SX99, the leads are plenty long, so no splicing is needed. The whole job takes only a few minutes. Before you start I suggest you buy a Photofact. You will need it when you find that your receiver alignment has gone south.

Fig. 1 shows the circuit I used. Although it differs from others published in 73, it works as expected and requires no changes to the original wiring. The results are amazing. Noise is no longer a problem.

If you are reluctant to deface your receiver, it would only take a few minutes to replace the 6SA7 and return to your original noise level.

With my new mixer, my xtal converters, and my Jim Kyle phase shift filter, I'll see you on 7015.73, and good listening.

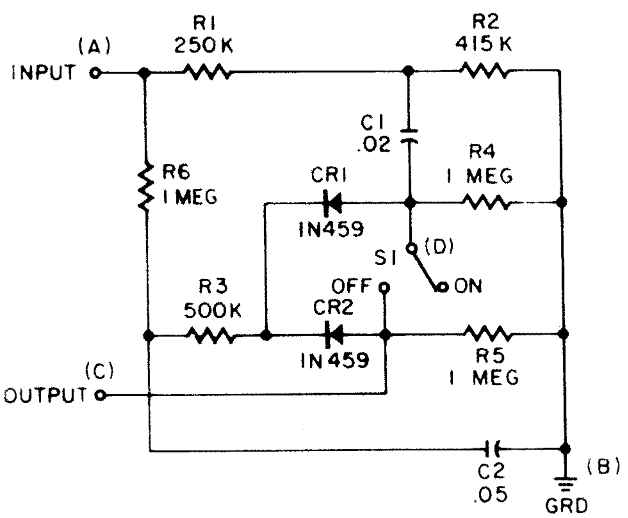
. . . K9ITR

Kill that QRN!

Ken W. Sessions K6MVH
4861 Ramona Place
Ontario, California

Solid State Noise Clipper

Most modern communications receivers are equipped with factory-installed noise-limiting devices; but either impulse-noise problems are becoming more severe or the "stock" noise limiters are becoming less effective. When an acute noise problem arises—as when first encountering the notoriously noisy mobile conditions of six-meter operation—and the built-in automatic noise limiter seems inadequate in its clipping depth, most hams spend some time on research. In the quest for easy and practical methods of impulse-type interference rejection, a mobile operator may be surprised to see the volumes that have been written on the suppression of noise at the source.



Unfortunately, source-type or "active" noise control can be a formidable task. The prospect of thorough bypassing, grounding, and shielding is often too involved to consider. But simply because the "passive" noise rejection of the built-in noise limiter doesn't always prove satisfactory, it is by no means proof positive that one need take "active" measures. The majority of commercially made communications receivers employ half-wave noise clipper circuits. That is, the positive audio half-cycle is clipped while the negative half-cycle remains unchanged. This allows a substantially undistorted audio output with a reasonable degree of impulse noise chopping. While this is generally acceptable, the more severe noise problems demand full-wave control.

While most hams are aware of the shortcomings of the conventional ANL circuits, few want to alter the appearance or circuitry of their "store-bought" rigs through modification or the addition of a home-brew accessory. An active amateur may have a transmitter under the dash panel of his automobile, plus a receiver or converter, and maybe even a power supply. The inclusion of another circuit would mean another black box—which is generally taboo with the xyl's.

So the limiter described here might just be the perfect answer to those "incurable" mobile interference problems. It effectively provides full-wave noise limiting and can be built into a unit small enough to mount in the actual receiver (under the chassis). And there is no need to change the receiver's physical configuration or electronic circuitry. Inclusion of the solid-state clipper into a receiver involves only soldering at three (or possibly four) points, and the disconnection of one wire (where a noise limiter already exists). This is no more effort than the soldering of a transistor into a circuit.

Theory of Operation

The limiter as described here was designed by Dick Hughes (W6CCD) of Pomona. He started with a standard circuit which employed a vacuum tube type dual diode, then substituted semiconductors in place of the tube. The inherent incompatibility of the original components with semiconductors necessitated other changes. The result is shown in the diagram. In this circuit, highly effective clipping with very low distortion is accomplished by clipping only on the positive signal pulses. The negative pulses are reduced in amplitude to a value approximating the clipped positive pulse. This gives a relatively noise-free output sine wave whose characteristics are essentially the same as those of a clean signal from the detector.

Actual clipping level is determined by capacitor C2. The higher the value, the greater will be the amount of signal clipped from the positive audio pulse, and the greater will be the amplitude of the negative cycle. The voltage difference between the unclipped negative half-cycle at CI and the unclipped reduced-amplitude negative half-cycle at C2

determines the level, or amplitude, of the signal at the output.

Experimentation has shown a value of .05 microfarad to be optimum for conditions of serious noise in receivers with a bandwidth of 2 or 3 kc. In broader receivers, the noise could be clipped closer with little increase in signal distortion. In highly selective receivers, however, with a bandwidth of 1 kc or less, the value of C2 might be raised slightly to assure distortion-free performance while still providing adequate impulse-type noise limiting functions.

The circuit is adaptable to any vacuum tube circuit and to hybrid circuits employing vacuum tubes in the audio preamplification stages. The filter is installed in series with the audio line between the detector and the grid of the first audio amplifier.

To summarize: the distortion is average, while the audio dampening characteristics are a considerable improvement over a conventional half-wave noise clipper. The effective clipping action under conditions of severe noise is dramatically distinct.

Construction

The following parts are required for the noise limiter:

R1–250K
R2–415K
R3–500K
R4–1 meg
R5–1 meg
R6–1 meg
CI–.02
C2–.05
D1–1N459
D2–1N459
S1–SPST

The resistors may be ¼ watt, if obtainable (a necessity where extreme miniaturization is required). The switch is not required, and may be omitted in installations where the circuit will be on at all times. The diodes may be replaced by either 1N457 or 1N458 as long as both diodes are the same. The only difference in these diodes is the peak inverse voltage rating, which will not be exceeded in any case. There is nothing critical in the selection of diodes for the noise eliminator. Any conventional diode with an extremely high back resistance and relatively low forward resistance will suffice. The diodes must be able to conduct under normal conditions without decreasing amplitude and to offer a nearly infinite resistance to pulses in the nonconducting state. All values shown are plus or minus ten per cent. The circuit point marked A is the audio input. B is floating ground or ground. C is the audio output. If there is already a noise limiter in the circuit, and it is not desirable to remove it or utilize the switch in the new circuit, simply disconnect the existing limiter from the audio input and prevent it from coming into contact with other wires. This will disable the existing noise limiter. Tie new limiter point A to the same contact point. Tie audio output C to audio-output point of existing limiter (the existing limiter may remain tied in at this point). If an on/off switch is to be used, the switch will connect between C and D. These two leads should be shielded to prevent pickup of noise and hum. When C and D are shorted (switch closed) the noise limiter is off.

Miniaturization Considerations

If care is exercised to keep all leads as short as possible, the noise clipper can be potted into a unit of less than one cubic inch. There is no need for hookup wire, either. Solder the elements as closely as possible, then save the excess leads from all components. These can be used as external leads from the clipper after hermetically sealing the miniature package. Once the noise clipper has been fabricated, choose the four longest leads saved from the original parts. Solder these to points A, B, C, and D so they all extend from the unit in the same direction. Code them in such a way that you can remember which lead goes where after the circuit is sealed. (One effective system is to cut lead A the shortest, with B, C, and D progressively longer.)

Potting

A very inexpensive method of packaging miniature circuits is to use ordinary epoxy glue. A "professional" looking potting job can be obtained by forming the epoxy glue over the components. Before sealing the unit, however, remember to test the circuit for proper operation. Once the circuit is sealed with the epoxy glue, there can be no trouble shooting or component adjustments in the noise clipper.

Another effective method of packaging is through the use of ordinary wood putty or "Plastic Wood".

Wood sealers work and shape well and dry fast. The major disadvantage here is that the consistency of wood sealers does not allow "dipping" of the circuit to provide isolation between leads. If wood sealer is used, the completed circuit should first be dipped into a "liquid tape" insulating compound—available at most electronics outlets. The liquid tape insulates all exposed conducting surfaces and allows the unit to be tightly compressed during the packaging process.

. . . K6MVH

Ed Sagatis WA2DJU
Amperex Electronic Corporation
230 Duffy Avenue
Hicksville, L. I., N. Y.

Take Full Advantage of Your Halo

For six meter mobile operation the halo antenna provides distinct performance advantages over whip type antennas. Included among these advantages are: higher gain; horizontal polarization to coincide with the base station; relative insensitivity to noise pick-up.

The halo antenna, with its high Q, possesses an undesirable narrow bandwidth characteristic. Therefore if you desire to QSY while obtaining optimum performance it is necessary to retune the halo antenna in order to present a 50 ohm load to the transmitter.

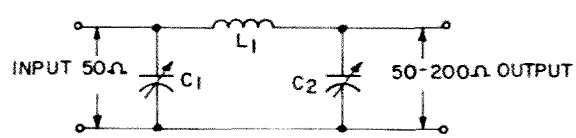


FIG. 1

PARTS LIST
C1 ARCO #463
C2 ARCO #464
L1 3-1/2 TURNS #16, 7/16" DIAMETER, 3/8" WINDING LENGTH

The majority of six meter transceivers use pi networks to transfer power from the final amplifier to the load. Unfortunately, many pi networks have a limited impedance matching range of 2:1 which generally causes a mismatch between the antenna and the amplifier.

Using the results of a recently published paper, "The Design of π Networks," by Mssrs. H. Kaylie and R. Bosselaers of the Amperex Electronic Corporation[1] Applications Laboratories, the mismatch disadvantages can be overcome. The matching network of Figure 1 is the familiar pi which has been designed

using this technique and will provide up to a 4:1 match from 50 ohms to 200 ohms.

There are several advantages to the design of Figure 1. Among these are:

1. It requires tuning of one element instead of the usual two.
2. It offers suppression of harmonic frequencies.
3. It has a relatively high loaded Q of 6.

The network can easily be constructed inside a minibox with appropriate connectors placed at each end. The values of the reactive components of the network for 6-meter operation are as follows:

C_1 = 110 mmfd max.
L = 0.18 μh
C_2 = 220 mmfd max.

Adjusting Procedure
(Refer to Figure 2)

The procedure for adjusting the pi network is:

1. Without the π network connected, set-up the equipment as indicated in Figure 2. Use the 50 ohm load. Tune and load the transmitter for maximum forard and minimum reflected power as indicated on the bridge.
2. Insert the pi netork and replace the 50 ohm load with the 200 ohm load adjust C_1 and C_2 to obtain the same bridge readings as step 1.
3. Replace the 20 0ohm load with the 50 ohm load and adjust C_2 for readings identical to step 2.

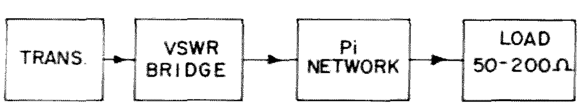


FIG. 2

The pi network is properly adjusted when the readings of step 1, 2 and 3 are identical. When this is accomplished, the network is ready for use and should be installed between the transmitter and the antenna.

When changing frequency, it will only be necessary to adjust C_2, and the final amplifier's plate tuning control.

The addition of this pi network to a halo antenna will provide a low vswr over a greater frequency range. This will result in a greater percentage of the final stage output power being delivered to the antenna.

Acknowledgement

The author wishes to thank Mr. H. Kaylie for his helpful suggestions. . . . WA2DJU

John Kline K9UTN
209 N. Dunlop
Viroqua, Wisconsin

Is Your Investment Protected?

The radio amateur has, as an investment in equipment, values ranging anywhere from $300.00 to $3,000.00, according to his operations and desires. In the accumulation of these values the thought of protecting that investment is often forgotten. Most people feel that their household contents insurance will protect them. This is true, with the exception, however, that many times increased values brought about by addition of equipment and the slow and gradual build up of equipment is overlooked. It is too late at the time of a fire or a windstorm to have your insurance increased. You must make plans for protecting that investment ahead of time.

Basically, two things are involved in thinking about protecting your investment. First, you must think of your values. When you are thinking of your values be realistic and consider the real value of your equipment. (Not the value that you tell your XYL that you have invested). Secondly, think of the perils involved. Most losses to radio equipment and accessories are caused by fire, windstorm and electrical damage. After considering these two items, insure to protect your investment.

Radio equipment and accessories are termed as "contents". The term contents in an insurance policy is very broad, covering "household and personal property usual to or incidental to the occupancy of the dwelling." (Ham equipment is usually primary to occupancy). It also covers property which you are purchasing on the installment plan, thereby protecting your supplier, and it protects equipment for which you may be liable. Coverage exists while contents are on the insured's premises. Premises includes the dwelling, the yard, etc. Therefore it covers property in garages and other outbuildings on the premises (This would include a separate shack which might be built for the purpose of seeking seclusion from local QRM from the family). An additional 10% of the insurance that has been placed upon the contents applies while away from the premises while anywhere in the continental United States, Alaska, Canada and Newfoundland. Therefore, this extension unquestionably covers property while in transit.

There are, in most states, four forms of insurance which can cover the exposures. They are as follows, with variations.

1. Standard Contents Form
2. Homeowner's Policy
3. Personal Property Floater
4. Specific Marine Type Coverage

We will discuss each form separately, discussing mainly the perils of fire, wind and electrical damage.

Standard Contents Form

The standard contents form normally is written to cover direct loss or damage by fire, lightning and extended coverage. Extended coverage is a broad extension to the fire policy covering windstorm, hail, explosion, riot, aircraft damage, vehicle damage and smoke damage. Most states exclude damage done to outside radio antennas, television antennas and towers, unless they are so named in the policy. In other words, you must insure them separately. This exclusion is most of the time written to apply only against wind and hail.

The modern insurance policy covers "consequential damage". This would be damage done to equipment while it was removed from the premises endangered by the perils.

For instance, a fireman might drop your KWM2 while taking it out of the basement to protect it; therefore, it would be insured against the dropping, although the fire policy in the standard form does not cover collision. It would also cover water damage done to the equipment while water was being played upon the house to fight the fire. Lightning damage done to the equipment is covered. However, in some states there is a code by the fire underwriting people whereby antennas and lead-in wires must pass through certain sizes of openings and must be held a certain distance away from the house. This

should be checked in your locality. Under the standard fire policy and extended coverage policy, electrical damage covered under the electrical apparatus clause provides that only the ensuing fire damage is covered if there is an artificial electrical injury or disturbance to electrical appliances, devices or wiring. There is written what is known as broad form extended coverage which does cover electrical injury or disturbances. However, in 1962, an addition restricted this electrical injury in that it eliminates all tubes, as well as transistors and similar electronic components. This was done, basically, to prevent fire insurance policies from becoming a "maintenance policy".

Homeowner's Policies

The modern trend in insurance writing is to the package policy. One of the package policies is called a Homeowner's Policy. It encloses under one policy form a coverage for the dwelling, contents, theft of contents, and your comprehensive personal liability. (Don't laugh at the personal liability part, your antenna may fall on another house and you would have a lawsuit on your hands, thereby being protected by the Homeowner's). The perils covered are basically the same as the standard dwelling and contents policies with some broadening. The added incentive is that it also includes theft, which could become quite important in the case of radio equipment. The fire coverage is basic and is as stated in the discussion on the standard fire policy.

In most states, the windstorm clause covers radio and television antennas without a separate endorsement. This is where it becomes beneficial to purchase a Homeowner's Policy. There are, under some policies, a deductible applying to that type of loss. It is permissable in some states to exclude the deductible by additional premium.

Electrical damage is covered under most of these forms, in that it covers sudden and accidental injury to electrical appliances, devices, fixtures and wiring (except TV picture tubes) from currents artificially generated. To the writer's knowledge, the recent 1962 restriction does not apply to Homeowner's policies. Check your policy.

The most important additional coverage afforded by a Homeowner's Policy is the theft coverage. It covers all of your contents at home to the limits of contents coverage written. And while away from home it covers up to the limits of at least $1,000.00. This would include equipment while in your car. The main thing to remember is that there is a normal exclusion on the Homeowner's Policy, excluding theft from the automobile while unattended and while in a public throughfare. (If somebody is going to hock your KWM2, be sure your car is parked in a private driveway or that you have the car locked so that there would be evidence of entry). You must remember that mysterious disappearance is not considered theft under most policies but under some policies can be included at an additional premium. Under most forms a deductible applies to all losses outside the realm of ordinary fire and extended coverage insurance.

Last but not least, under the Homwowner's Policy, your personal liability is covered. This could become important, as I stated, in case an antenna might fall on some property or somebody. (Unfortunately, it does not cover TVI complaints).

Personal Property Floater

The personal property floater is, in the terms of an insurance man, an "All Risk" policy. Many times this policy is written with a $50.00 mandatory deductible applying to all losses except normal losses from fire and extended coverage.

It covers all the losses named above, including theft. As a matter of fact, the perils which are covered are not named. It merely states in the declarations of the policy that it covers *all risk of damage* to your personal property except those which are excluded, and that is usually wear and tear, water damage caused by backing up of sewers, and damage done to equipment while repairing or reworking. This is the advantage of this policy. It does cover physical damage to the equipment of some types of which we don't even think about. For instance, you might leave your yard sprinkler on with your window open and the equipment may become water soaked. This would be collectable under the personal property floater.

Under this policy, mysterious disappearance is covered. If you come home and your beautiful KWM2 is missing, without any evidence of entry, you have coverage. As a matter of fact, to be ridiculous, if you drop your transmitter in the pond while transporting it from your car to the picnic table, there is coverage.

The electrical damage clause on this policy is limited to the point that it only covers damage done to equipment by the ensuing fire. Lightning is not classed as electrical damage, but arcing is.

Under the personal property floater TV or transmitting towers are considered real estate and, therefore, are not covered under the

contents policy and so should be covered in the dwelling policy. The confusing fact about it is that the radio antennas themselves, such as a two meter antenna or a six meter antenna, are covered under the contents portion of the personal property floater.

Specific Marine Type Coverage

There is available a specific policy written covering transmitting and receiving equipment as well as radio and television towers, either of a permanent or mobile nature.

This policy insures against all risk of loss or damage much the same as the personal property floater does. The conclusions to be drawn for the radio equipment marine policy is that it specifically includes either on a blanket basis or a named basis, all radio equipment and accessories. The advantage being here that you will then be sure that you have all your values covered. Also under this, the antennas are covered if named.

Conclusion

The point in fact is that in order to protect your investment you must be sure of your values. Be sure to consult your local insurance agent about the terms of your policy. Above all, be sure to insure your investment.

. . . K9UTN

K5JKX—Our controversial author.

Dear Wayne:

I just finished reading through the September issue of "73" and was quite interested in the article "More On the 6DQ5" by K5JKX. I believe I have another interesting little bit of information that can be added to this that will only help to verify his information.

Recently, I purchased a used Swan SW-240 rig from a chap that had (apparently) had a bit of trouble with it. After I fiddled around with it, checked tubes and so on, I decided that I'd better call on the Swan people down at Oceanside for a little assistance as I couldn't get the little monster to fire up "the way the book seze." A phone call and a nice shoreline drive down to Oceanside introduced me and my XYL (K6OAO) to some of the most cordial and friendly amateur radio gear manufacturers that I have met in over 17 years of hamming! ! ! The Customer Service Rep met us and listened to my problem with the SW-240 and tucking it under his arm, he started for the door leading back into the "secret chambers" of the organization. K6OAO and I were just getting ready to spend the usual "hours" sitting in the waiting room when this C. S. Rep. said, "come on with me, you wanna see what's going on with your rig don't you? ! ? ! ?" Stunned, we followed him back to the customer service test bench . . .

To shorten the story, one of the first things that he did after removing the cabinet was to remove the "Belch Fire 240" 6DQ5 and throw it into the "good for TV servicing only" box. Having just checked the tube the evening before and knowing that it was a real hot bottle, I naturally became a bit concerned . . . Seeing my obvious displeasure, he advised me that the **ONLY** 6DQ5 that they could count on for completely satisfactory service was the one made by RCA . . . Replacing "my" 6DQ5, he took the time to completely realign the transmitter complete to neutralization on 20 Meters. With that he showed us the neutralization on 40 and 75 Meters. The final was running completely wild! He neutralized it for 40 Meters and it was out on 75 and 20 Meters. Down on 75 Meters, that 6DQ5 retained a mind of its own! ! Reneutralizing on 20 Meters, he showed us our power output with a wattmeter.

Then, replacing our 6DQ5 with a new RCA bottle, he reneutralized the final and it was good on all 3 bands! He then showed us the power output with the wattmeter . . . That was enough for us . . . He also gave us a considerable number of little pointers in loading and operating the SW-240 that have helped a great deal in its operation here at the home station. Since we've had the rig back home, it has operated like a brand new machine . . .

Being a Federal employee, I am not associated with RCA in any way and Swan is not "pushing" RCA tubes but this demonstration at the factory has certainly caused me to "eye ball" the same tube but by different manufacturers with a critical eye when replacing any tubes in our amateur gear . . . There is a difference in performance . . .

With the number of Swan rigs in use now, I feel that this information is of value to every Swan owner who uses the 6DQ5 in the final amplifier. For all I know, this information may also apply to other 6DQ5 rigs . . . I just wanted you and "73" readers to know that K5JKX's article has very definite merit and isn't just something to fill-up more pages of a monthly magazine.

You publish a dern nice magazine.

E. L. Hollis, W6ZGZ

Dear Mr. Green:

With reference to article, Class D Amplifier, May 1964 issue of your magazine by Mr. Jim Kyle, I respectfully suggest a severe caution to any of your readers who are inspired to build an audio amplifier with 99 percent efficiency. Albeit this pulse coding technique is very ingenious and not without many promising applications it by no means allows for such a high efficiency. Out of curiosity I have worked out the mathematical power spectrum for this type of signal and determined the relative power that will be present in the audio region of the signal, and the relative power that will be present in the rest of its spectrum. The maximum percent of the total power present in the audio region can not exceed 62.5 percent. Thus assuming that the transistor is operating at 100 percent efficiency one still looses 37.5 percent at least of ones power in the transformer or low pass filter. None-the-less, one can scarcely assume the transistor to operate that efficiently. The saturation resistance of the transistor may vary up from fractions of an ohm to as much as ten or more ohms. Unless the transistor is matched to an appriately high impedance, the transistor will dissipate a significantly high percentage of the power at the output terminals.

Finally a word about frequency response. Analysis of the frequency spectrum of the class D signal shows that the audio appears as the "zero order" component of the square wave sampling frequency. The fundamental and each overtone of the square wave carrier becomes frequency modulated by the signal and gives rise to side bands that can overlap the audio spectrum itself. The choice of a five to one ratio between the highest frequency of the audio and the square wave carrier frequency is about minimum. Also about five overtones are about minimum for reproducing a good square wave, so that all together one needs a transistor that can handle frequencies about twenty-five times those one wishes to amplify. All this is for a gain of 12.5 percent over the maximum possible efficiency of a class B amplifier.

Karl A. Stetson
Graduate Research Assistant
University of Michigan

Dear Wayne:

Care to get a little power supply discussion going? I was intrigued by the supply in W6NKZ's linear amplifier article in the December issue. It is a full-wave "tripler" first described in a staff article in 73, June 1961. [Ed. note: by Jim Kyle K5JKX]

Clark is right that "tripler is a slight misnomer"; it is a full-wave *doubler*. The extra two diode legs of the bridge don't do anything because they are always back-biased. This probably accounts for the observation in the staff article that "most reference books fail to mention its existence and no commercial design using the circuit could be located."

The idle diode legs are the ones shunting the filter capacitors. This figures. It's hard to imagine how a diode bypassed with a husky electrolytic could see any ac to do anything with, isn't it? The rest of the circuit is the full-wave doubler of Fig. 8 of the staff article. The doubler keeps each capacitor leg charged to something near the peak ac voltage, and this holds the idle diodes always back biased.

Shamefully lacking courage of conviction, I built one and tried it. With a transformer providing 22 vac rms (something I could get my fingers into) and 120 mfd capacitors, the output voltage was about 60 volts no load and 50 volts dc with 125 ma load. Removing the idle diodes had no effect at all.

The full-wave doubler provides a no-load output voltage of 2.83 times the ac rms input voltage, and the way things usually work out in practical circuits the loaded output voltage runs around 2.2 to 2.4 times the input rms voltage.

My guess is that Clark used the full secondary of a transformer providing about 350 vac rms each side of center-tap. Such a transformer would give abt 400 vdc in a capacitor-input TV-set full-wave rectifier, but using the full secondary (700 vac rms) in a doubler would give 1980 vdc unloaded and 1540 to 1680 vdc loaded. Just about what Clark measured.

So it looks like Clark has eight spare diodes he can put back on the shelf. How about it? Is the circuit drawn wrong in the staff article and there's a slight rearrangement that works?

Larry Clayton W4LDB

Letters

Dear Wayne,

You wrote in a recent article that you were using a six meter 16 element colinear beam. I have been unable to find any information on a beam of this type. I would deem it a favor if you would advise me where you purchased this beam.

A. Cutler WA2ONB

Well, A, Cushcraft just happened to have one of these things lying around their storeroom when I visited one day. I called them for you to find out if they had made any more and found that they will make, on order, a similar beam, one with 24 elements, a combination colinear and yagi beam. I'm using these types on two meters and find them terrific. The price on the 24 element job is $125. My order is in for one; I don't want to chance your being any louder than me.

Dear Wayne:

I just received a copy of Washington Amateur Radio News (not requested) and on page 3 there is an article about the ARRL requesting a commemorative stamp for amateur radio.

This letter is to inform you that they didn't know about the stamp until the president of the Teaneck, N.J. Police Athletic League Stamp Club wrote to them and asked their permission to use the call letters W1AW on the cache envelope to be issued by the P.A.L. Stamp Club in conjunction with the P.A.L. Radio Club, WB2NUW, the first P.A.L. radio club.

The ARRL ignored the letter and capitalized on it. The stamp will soon be issued and the cached envelopes will be sponsored by the Institute of Amateur Radio. Please print this letter and let anyone try to dispute it.

Raymond Vath, WB2FYB
IoAR #85

Dear Wayne:

I would like to recommend to you and any reader who has some background in science at the college level that a subscription to "The Journal of Irreproducible Results" is well worth the dollar it costs for a year (three issues). It is available from Dr. George Scherr, Consolidated Laboratories Inc, Box 234, Chicago Heights, Illinois. The articles in the Journal are so funny it hurts.

As far as K2US . . . first of all, a ham station on the second floor may impress the hams who make contact with it, but the general public isn't going to know it exists. When I pointed this out to Mr. Dannals at the HARC Convention in New York, he said (in his usual "polite" manner) that the station was to publicize the Fair among hams! What about the general public? Isn't there some reason (like TVI maybe) for showing people that hams aren't all a bunch of morons who botch up their TV reception? Isn't there the idea of getting people interested in ham radio as a hobby? No, the purpose is to let other hams know that the World's Fair has a ham station.

Operating? Forget it. Dave Popkin WA2CCF was there and certified that my license was valid on the opening day of the Fair. I filled out an operator's application sheet and that was that. I never heard a word from them. I called the station twice and was told both times by the station manager that I would hear from them in a few days. I heard nothing. Bah.

Norm Goldman, WA2JIS

Dear Sir,

Reference to your cover on the December issue of 73. Either the Eskimo is far from home or the penguins are. Eskimos are from the arctic and penquins from the antarctic.

Ernest Harris W1PZU
Manchester, N. H.

73 spares no expense to bring you attractive covers.

Dear Wayne:

I have been prompted to answer your editorial in the current issue of 73, concerning the history of your career through several ham magazines and the present venture.

First of all, let me say, that I believe 73 is the finest ham magazine available. Your technical articles are well-done and easy to understand. I would like to see, however, a roundup of FCC actions every month, similar to that in magazine "Q." I subscribe to the Newington rag mainly to keep up with allocations, and various changes in regulations. If you could publish these, it would be very helpful.

Next, I know how you feel, and I must agree with much of what you say. However, I feel you are in danger of trapping yourself in a position of being opposed to ARRL just for the sake of opposition, even though you may not feel that way, entirely. Those of us who are rebels in this world, always have a hard time staying out of trouble. We all basically feel antagonistic towards the "establishment." So, even if they win the battles, the fact that you are a dissenting voice is so important, that it should be heard at greater volume.

As you do, I am beginning to feel that ham radio is in danger of extinction, not from *too many* Technicians and Novices, but from a lack of interest in preserving it by the hams themselves. Most amateurs, unfortunately, are not too well read outside their field. Most are poor at self-expression (witness the pointless QSO's and the characters you meet at hamfests) and most are unwilling to be counted.

I have decided, after some deliberation, to send you 10 bucks and join your IoAR. I don't know if I'll be wasting it or not, but at least I'll be supporting a good IDEA.

Keep up the good work, but *in my opinion*, you should now be getting more POSITIVE with solutions of your own.

Joel Rose W3AFY
Pittsburgh, Pa.

Dear Sir:

Will you please provide me with the correct name and address of the department in charge of the meeting to be held at Geneva in the near future.

The writer has made an honest attempt to lead an honest and honorable life for quite a spell and honestly believes that he worked what we used to call "Wireless" prior to the advent of the so called ARRL but at this late date is finding it difficult to get anything more substantial than evasive or wise crack answers out of the so called headquarters. Perhaps, there is another way around.

When the writer asks civil questions in a civil manner he thinks he is entitled to an honest straight forward answer and not what Headquarters seem to refer to as a "Formulated Answer." Anyhow think it is worth a try.

A. Lee Chamberlin. WØCZ
Des Moines, Iowa

The conference is managed by the International Telecommunications Union in Geneva, but this is an impersonal agency, similar to the U. N. About the only people who can answer questions are those who have attended ITU conferences such as John Huntoon, George Jacobs W3ASK and myself.

Dear Wayne:

Please confirm or deny ugly rumor by ARRL member that you are no longer buying construction articles on spark gap transmitters until 1968 due to large stock on hand.

Ralph Loackard, K6GOQ

A quick look at the transistorized quench-gap rig by W. Coward K2PMM on page 137 of this issue should dispell this irresponsible rumor. 73 is always in the market for state-of-the-art spark rigs. Watch for a beautiful varactor silicon-controlled mulched-gap spark rig coming soon.

(W2NSD—from p. 4)
to do next. I was a tour director. And that is what I did for the whole trip . . . directed. I never got to see the sights or do much shopping anywhere for I was too busy keeping the tickets straightened out, finding baggage, arranging for busses, getting hamfests put on, etc. I'm not complaining for I enjoyed it and I wouldn't mind doing it all again.

Not that the occasion will ever present itself again I suspect, for the response to my proposed Scandanavian tour was even less than the European tour, with most of those wanting to go being the people that made the European trek with me. It seems that it is just possible that the great bulk of the hams that might go on a tour went on my tour . . . perhaps there are only 73 of us interested in it . . . out of 250,000. Hmmm.

I'll make a deal with you. If I get letters from at least 150 of you saying that you are definitely interested in a three week European tour for September 1965 I'll start the ball rolling. I want a complete jet this time though. The price will have to be a little higher than last time since I found that there were dozens of extras that I had to take care of such as airport taxes at most airports, hamfests (I picked up the entire tab for dinner for our group plus a goodly number of London hams, etc.), sightseeing in East Berlin and West Berlin, busses to and from the airports in all cities, busses to hamfests, and on and on and on. Figure on $650 per person for the three weeks, all expenses paid except lunches and dinners. This will coincide with the 1965 International Amateur Radio Convention in Geneva, by the way.

Anybody want to go?

K6BX

A letter from Clif is always an event. They are pretty much like his news bulletins . . . and if you haven't been reading them then you've been missing an emotional experience. Clif whips himself up into full blown indignation at the gosh-awful things that are going on in ham radio these days. He gets up a good head of steam, but you know, he is usually right in there with his facts to back up his carrying on. I haven't seen anyone yet that has been able to call him a liar.

Except possibly some yellowing ham magazine that recently brought out a thin anemic little dollar issue with some boy trying to do a hatchet job on BX in it.

So, anyway, there's this letter from K6BX. Clif suggests that we take a peek in the CB magazines and see what is happening there. He points out that there is a major move to make a home for the poor downtrodden ham-type CB'ers on the top end of our two meter band. He wonders why ARRL has kept so quiet about this in QST and why CQ is supporting this move through their CB magazine S9.

This seems normal to me. The ARRL has recently petitioned the FCC to prevent any further use of the top two megacycles of two meters by hams in their rebuttal of RM-399. If they were planning to move the CB'ers into that band this suddenly makes sense. Many of us were flabbergasted when they opposed 399, never thinking of this development. This also fits in with the hushed-up proposal that ARRL President Hoover reportedly made at the Disneyland convention when he was first elected wherein he suggested that the top two megacycles of six meters be given over to the CB in order to keep them from trying to get ten meters from us. Are we being sold down the river from within?

Visiting Ops

Though I try pretty hard to keep up on the twists and turns the FCC takes in making and interpreting rules for us, they came up with a new one the other day. The FCC had always interpreted their rules to mean that specific equipment was licensed with call letters, not the operators. They even went as far as to request licensed wives to use their husbands call when using his equipment, etc. Now apparently all that has been changed. It would now seem that the operator should use his own call on any equipment that he is controlling. This certainly will cause great difficulties come Field Day and during any other multi-op contests.

Here is exactly what I received from Mr. Waple, the FCC Secretary: "In reply to your recent letter, you are advised that if your individually licensed amateur radio station is operated by another amateur operator while you are not in actual control of the station, your station call sign may not be used. 'Control,' for this purpose, contemplates the ability to both monitor the station's operations and to terminate operation immediately for any impropriety or malfunction."

You can see that it is obvious from this that multi-operator stations are a thing of the past and should any such operation be attempted in upcoming contests they will have to be disqualified for failure to comply with FCC regulations.

Also it is contrary to the FCC interpretation of their rules for anyone but Ed Handy, the licensee of W1AW, to operate W1AW using that call. Every other operator must use his own call unless Ed is right there in control. It will be interesting to see if the League continues to operate W1AW in violation of the FCC regulations.

This should put an end to K2US and other special events stations where the licensee custodian cannot be always present. Each operator will henceforward have to use his own call.

I'm a troublemaker.

Xerox?

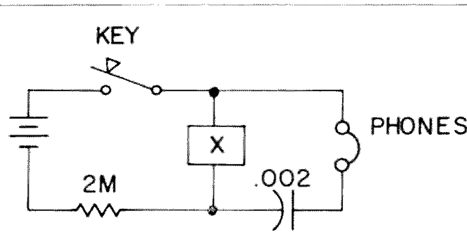
Perhaps you've seen the television commercial with the big contraption sitting in a darkened room . . . the light snaps on and this cute chick swings in, flips a knob for the number of copies she wants, puts the letter to be copied in and walks out a minute later (or less) with 23 copies of the letter. I think they said it was a couple cents a copy.

My reaction to this was, "Hmmm, that should be in the FCC offices so we wouldn't have to send in 15 copies of everything." Quite a few fellows have grumbled about this severely limiting requirement for filing comments on dockets.

There are, of course, two sides to the requirement. There is no question but that it eliminates a lot of useless junk from ending up in the docket files. There is no purpose to having hundreds of postcards on file, each saying that they are opposed or are in favor of a docket. The FCC is interested in the reasons for your position, not the position itself. They are supposed to make their decisions based on all of the factors involved and it is up to the amateurs to make sure that the Commissioners have all of the facts.

On the other hand, anything that limits the ability of the FCC to get the facts needed to make the best decision can only work to the detriment of amateur radio. Perhaps it is time for the FCC to invest in an automatic copier? Even if we had to include a dollar copying fee it would be well worth while. This would also filter out the postcards.

. . . W2NSD/1



What component or circuit would you put at "X" to end up with a code practice oscillator? Ans. p. 81.

Frederick Durham K1VDX
E. Swanzey, N. H.

RDZ Receiver

While trying to find a cheap way to effectively receive 220 mc and 435 mc signals, I learned of the RDZ Receiver, a National product which tunes from 200 to 400 mc, which is now available in surplus. Although the 60 cycle model is a good buy—anything that weighs about a hundred pounds and has 22 tubes is tempting—the receiver is also available in a 400 cycle model at just over half the price of the 60 cycle model.

The conversion to 60 cycles is so simple that it is worth doing to save the money. The following conversion takes less than two hours to put the set into operation.

The power supply section is converted first. Connect a power cord to pins A and C of the power input plug. Remove the bottom plate of the power supply section. Remove and discard the 400 cycle filament transformer, the accompanying potentiometer, and the associated wiring to the power transformer and to pins *one* and *two* of E-302. In the unit converted, the 60 cycle power line in and the 12 volt power line out enter under the feed through terminal board to the rf section, rather than as shown in the schematic. Leave these as is. There should now be no wires connected to pins 1, 2, 3, and 5 of the terminal board E-302. Solder the red wire clipped and folded under the resistor board to the top center 0.1 capacitor lug (as seen from the bottom of the set). This completes the power supply section conversion.

Next, remove the bottom plate from the af if section. Remove the pair of wires from pins 1 and 2 of E-202 and connect one of these to ground at the adjacent resistor board. Connect the other to 6.3 heater voltage at any one of the sockets in the rear tube row. For an external speaker, connect a 500 ohm line to voice coil transformer to pins A and C of the audio output plug; connect speaker to the secondary of the transformer.

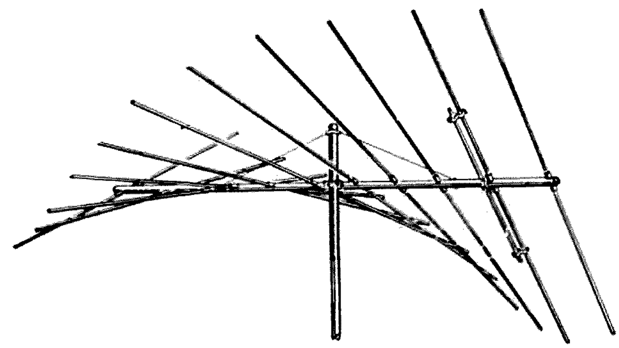
Finally, the autotune must be modified or disconnected. Three variations are possible. To use the autotune and crystals, replace the 400 cycle motor with a similar 60 cycle motor (Eastern Air Devices, 100th hp. made for Collins). After replacing the motor, remove wires from lugs 15 and 16 of the autotune strip on the top rear of the autotune (blue and white). Then trim added wire (red and black) from the red and yellow pair coming from E-203. Connect the remaining yellow wire to 15, the black to 16 of the autotune strip. Finally, cut out and discard the two pairs of wires (blue and white, red and black) previously disconnected.

For manual tuning with crystals, leave the wiring as it is and do not turn on the autotune; use the receiver manual tuning in conjunction with the input meter to peak the set for each frequency tuned.

For variable tuning, any small 4.5 to 7 mc oscillator may be plugged into one of the crystal sockets and peaked for each frequency with the manual tuning control.

. . . K1VDX

So We Bought a Spiralray—



Joe Marshall, WA4EPY

—the midget model with 27 ft. boom, that is. The big brothers have booms some 36 and 47 feet long respectively.

The Spiralray is a mighty odd looking beast. It looks like a big Yagi that has been through a tornado. The elements make a 90 degree twist between the reflector and the last director.

The theory is that the Spiralray transmits a circularly polarized signal, similar to a helix. Like a helix it attains maximum gain when the antenna at the other end is also a Spiralray. In the case of the 27 ft. model, the claimed gain under this condition is 16.5 db. The gain is about 1 db less when working either a horizontally or vertically polarized signal. This offers no great advantage in my area since most six meter hams here use horizontal antennas. Even the mobiles favor halos over whips.

However, only the short-range, obviously line-of-sight stations actually deliver a signal at the receiving end that is polarized the same way that it is transmitted. If the signal is reflected or deflected either by the ground, a ridge or an ionized layer in space, the polarization shifts. So that, what started out as a horizontally polarized signal may end up at the receiving location with vertical polarization or something in between.

Furthermore, the shift in polarization is not always a constant one. Over any interval of time the polarization may shift many times through the 90 degree angle between vertical and horizontal. An antenna with fixed polarization suffers considerable loss as the incoming signal departs from its own polarization. Thus a horizontal antenna may be as much as 20 db or more down for a vertically polarized signal and vice-versa. The actual field strength of an incoming signal may be fairly constant, but the shifting polariaztion produces a large variation in the voltage developed across the antenna. This accounts for a good deal, if not most, of the QSB on long ground-wave and skip reception. Therefore, the Spiralray, with equal sensitivity to any polarization, should in theory produce better results than a Long John with the same gain, but for only one mode of polarization.

This was particularly attractive to me because few signals arrive here by a direct path. Though my elevation is 1700 feet, it is surrounded in every direction by ridges 200 to 1000 ft. higher. Thus I experience a shift in polarization on almost all signals, so you can see that an antenna which is relatively insensitive to differences in polarization would be just what the doctor ordered.

The Spiralray arrived in a surprisingly small package—about 10 ft. long, 5 inches square and weighing only 27 lbs. Like all Telrex antennas, it was well made. The radiating element is tubular, the others are solid aluminum about ⅜ inches in diameter. The boom comes in three section which fit snugly together and are anchored with bolts. The holes for the elements are drilled with great precision, which must be quite a manufacturing trick.

The instructions are on the blue-print and drawings. The elements come cut for 50 mc and should be cut a total of 1 inch for each ½mc increase in center frequency. The elements slide smoothly and snugly into the holes on the booms. Obviously the smart thing to do is to assemble it in three sections. It takes some time to get the elements precisely centered since this is a tapering type Yagi and each element is a different length.

To match the feed while the antenna was within reach I assembled the beam on a 10 ft. mast. To keep the long boom from droop-

ing there are two wire struts supported about 4 ft. above the boom on the mast and going out some 6 or 7 feet to appropriate points on the boom. The struts were easy to adjust at this point since, with the tower on the ground, the boom was only some 6 ft off the ground.

The Spiralray comes with a balun to match 50 ohm coax. I set the T match by ruler to the indicated points and hooked up the balun and through 50 ft. of coax fed it 200 watts of rf. A Knight SWR bridge indicated an SWR of 1.5 at 50.9 mc and dropped below 1.2 all the way down to 49.98. Connecting odd lengths of coax to the line did not affect the SWR.

Results

The SWR remained low despite several nearby trees after it was raised.

The reports from stations within 50 to 75 miles, with presumably minimum polarization shift, give me gains of about 6 db over the 5 element antenna I had used previously, and this corresponded to the receiving gain. This figures since the Spiralray has a claimed gain of about 4 db over the 5 element, and the improvement in SWR could easily account for another 2 or 3 db.

The Spiralray does produce a really dramatic improvement over the horizontal antenna when working stations with vertical antennas. I can work mobiles with whips far beyond my previous range, and often when they are completely inaudible to nearby stations using horizontal antennas. I have worked mobile Sixers loaded into whips, in motion, as far as 70 airline miles. The mobile flutter is very markedly reduced.

The Spiralray has a very useful beam pattern. Although the front lobe is broad—about 35 degrees—so you don't need a surveyor's transit to be sure of getting into a given place. On the other hand, it has a very sharp null at about 90 degrees—something more than 40 db, and enough to take even a very strong signal right down into the noise. The flatness of the front lobe makes it often possible to null out QRM without reducing the signal strength of the desired station significantly, by changing the antenna direction to a few degrees. The null is sharp enough to measure direction within a few degrees.

The front-to-back ratio is 28 db with small minor lobes at about 45 degrees.

There is a definite improvement in the depth of fading of long ground-wave signals. Paths which formerly gave as little as 25% readability over a 5 to 10 minute contact now provide well over 75%.

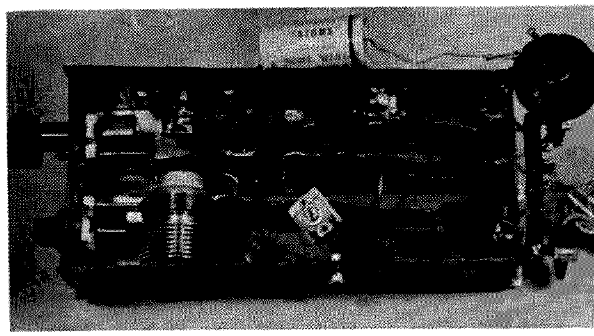
I have worked only one other station using a Spiralray, W4VIW in Greeneville, S. C., 150 airline miles and several mountain ranges away. He feeds his Spiralray with a Zeus. While I have worked this path quite consistently in the past, no station down there ever delivered a signal in excess of an S5 or 6. W4VIW peaks as high as 10 db over 9 and with a surprisingly constant signal. He reports similarly. To cap it off, he is just barely readable to other stations in my area which previously had reports over this path comparable to mine.

It is difficult to assess skip performance of antennas since there is so much freakishness involved in the whole business of skip communication. However, that is what we noted during openings: The combination of our 200 watts of rf and the Spiralway gave us "top-signal-on-the-band" reports repeatedly. We practically never had to make more than one brief CQ or call for a specific station. We enjoyed a "first-in-last-out" position in our area in virtually every opening. For example, we heard and worked VP7CX some 15 minutes before anyone else in this area heard him and we were the only station he was reading for an equal period. We were the first to hear and the only station in this area to work VP5BB on Turks Island one day, and K4PGL/VP9 one evening during a period of very erratic shifting skip. We worked stations in Maine, New Brunswick and Nova Scotia another day in brief openings when the band was seemingly dead. Finally, it does appear that the QSB on reception of skip signals is considerably reduced.

All in all, the Spiralray does the job it claims and has improved our station capabilities considerably. We can recommend it wholeheartedly to any serious VHF worker.

. . . WA4EPY

There has been tremendous interest in the VHF linears in September 73. This article will give you more insight into AM linears for VHF.

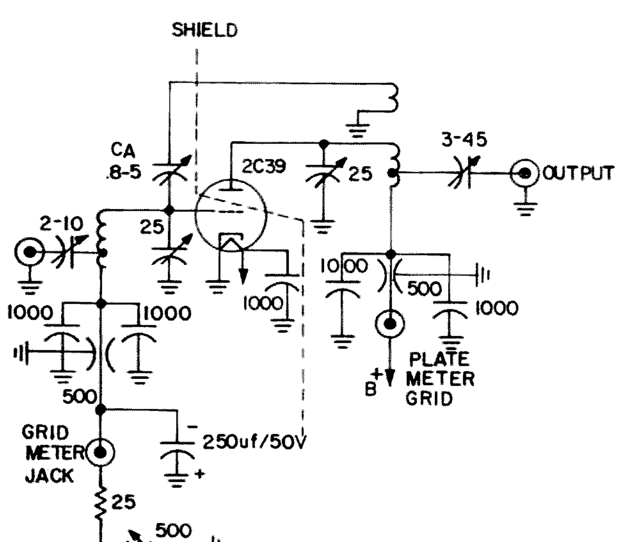


Low Cost, Powerful Two'er Linear

Bill Hoisington K1CLL
Peterborough, N. H.

Introduction

There are several new features in this linear for the Two'er which we trust will be of use to the developing amateur who is still struggling to acquire his education. An excellent triode tube is available surplus, at prices beginning around $4.50. It is also available new in quite a few different versions, specs, and prices, because it is a really unique kind of tube.



After getting this tube, all you need is some copper-clad bakelite, a few small capacitors, phono or UHF jacks to suit your cable connectors, and a home-brew power supply, as from an old TV set. You do not have to modify the Two'er in any way. Just plug the Two'er rf output cable into the rf input jack of the linear, using the microphone and modulator of the Two'er. Plenty of details follow.

VHF Neutralization

This is quite a subject. We are going to take a good look, so get hold of a glass of your favorite fruit juice and settle down.

Plenty of excellent reference material for hf neutralization is available but the handbook writers begin to hedge as soon as they go up past 30 megacycles. They are also on relatively easy ground with the $20 double-pentodes for VHF, but when it comes to something inexpensive, simple to build, and powerful, where are they?

My first experience with the reality of VHF neutralization came with the 815 double pentode in 1940, a mere 24 years ago. This was to all intents and purposes two 6L6's with plate caps, and a handy octal socket. "TNT" circuits were quite the thing then on 2½ meters. That was a tuned plate, tuned grid, modulated oscillator. Worked fine with triodes. With the two pentodes in the 815 envelope, weak oscillation. Why? Without going into too much theory at that time I experimented with MOPA, (master-oscillator, power-amplifier) neutralization, and the 815 as an oscillator. I soon found out by trying various values of neutralizing capacitors that the natural internal grid-plate capacity of the 815 was just enough to cause weak oscillations, but not enough for much rf output as an oscillator. By adding neutralizing capacity, the usual push pull cross over type from one plate to the other grid, the tube could be neutralized and would run fine as an amplifier. Then, by increasing the Cn's, a good oscillator could be obtained. Don't forget, those were the days of the modulated oscillator.

So we find ourselves today with practically nothing about triode neutralizing for VHF in the amateur handbooks. This in spite of the fact that there is a 100 watt triode with a transconductance of 24,000 micromhos with full ratings to 2500 megacycles, that you can buy for as low as $4.50 surplus.

What does the old reliable RCA handbook have to say? No help there either.

Plenty of dope on how to neutralize an amplifier that is already built, and a few words on neutralization in general, triodes and pentodes, but nothing on VHF. What gives? Are some people that determined to sell $20 pentodes to lads who just cannot lay out that kind of dough?

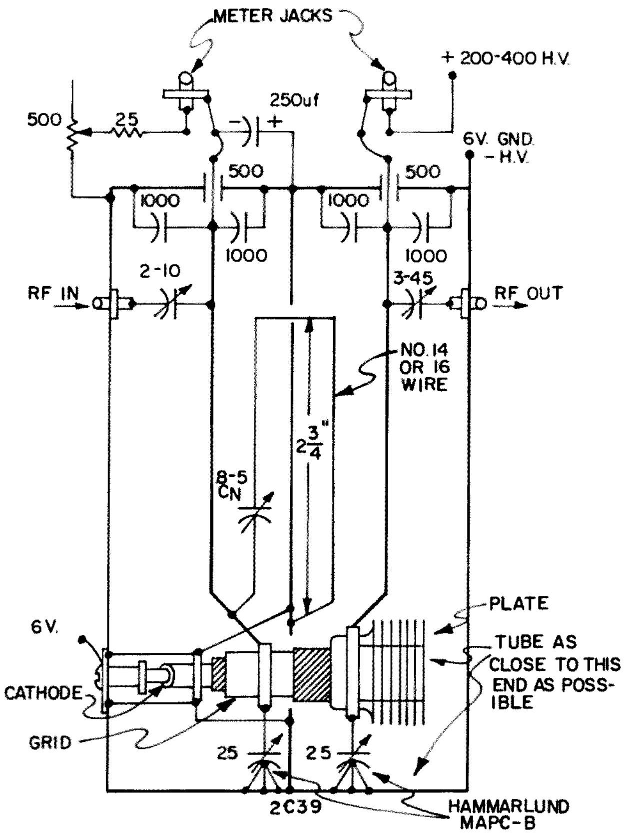


Fig. 1. 144 mc linear amplifier.

Let's look in Bill Orr's VHF Handbook. Plenty of real good dope in there on lots of VHF problems. A good 3½ pages entitled "Analysis of neutralizing circuits". Starts right in with a tetrode tube. No mention of triodes there. Further along in the book under "The grounded-grid rf amplifier" we find "One of the undesirable characteristics of the conventional triode rf amplifier is that the stage must be neutralized to prevent self-oscillation". "As the frequency of operation is raised the stage becomes increasingly difficult to neutralize . . .". Then there are several paragraphs on the advantages of the grounded grid amplifier. No diagrams are shown of a simple grounded cathode VHF neutralized triode stage.

One more handbook: "VHF for the Radio Amateur", by Frank C. Jones. At least on page 5 there is a picture of my favorite, the 2C39, among other UHF tubes. He starts right in on whole circuits for transmitters, beginning at 50 megacycles. (Incidentally, I think a great deal of this book as far as it goes.) He carries 144 mc into a pair of 4CX250B's, tetrodes, which is fine, but way out of the price range at present. At 432 megacycles he gets to the 2C39 tube and says ". . . it will function effectively if driven hard by the exciter." This is in a grounded grid circuit, and is just one of the disadvantages of the grounded grid. He makes no mention of any neutralization, relying on the "grid-separation" circuit to keep out self-oscillation. Which is ok but does not allow small drive power, as from a Two'er.

Well, so much for VHF neutralization in the amateur type handbooks. Now where do we go?

The 2C39 Tube

I have talked about this rugged (I haven't burned one out yet and still haven't installed a blower), low cost surplus, 100 watt capability (*with* blower!) tube and how it works on 432 mc with easy-to-build series tuned trough lines, etc. Now let's see what this tube is like. It is the first tube in the "RCA Transmitting Tubes" technical book series. That's just a numbering accident, but makes it easy to find. "May be used to 2500 mc at full input", this book says. That should cover 2 meters all right! Then we see on the third line "Transconductance equals 24,000." Going back to the ARRL "Radio Amateurs Handbook" for the definition of transconductance, we find "The best all-around indication of the effectiveness of a tube as an amplifier is its grid-plate transconductance." "Transcoductance is the change in plate current divided by the change in grid voltage that causes that plate current change" with fixed plate voltage. The transconductance of some comparative tubes follows: 2E26, 3500; 832, 3500; 807, 6000; 6146, 7000; 829, 8500; 6969, 10500; 6CL6, 11000; 417A, 24000; 6897 (2C39 type) 24800. The only tube that is in amateur use I know of that has a greater transconductance is the 416B gold-plated triode, a special receiving or low-power transmitter tube, at some 30,000 to 40,000. (when new!)

Bear carefully in mind though, that a 2C39 must be used in a ***grounded cathode grid drive*** circuit in order to use that Gm of 24,000.

Connections

The next thing special about the 2C39 is the connections. No pins, no leads. Just *surfaces!* While cylindrical cavities are fine and a real must around 1296 and up, you can get along ok on 2 meters with properly used trough lines. Using a one inch strap for the grid and plate conductors (one for each) or lines, you can cut out a semi-circle in the end of the strap, see Fig. 4, and get a large area connection right onto the plate and also the grid, through, of course, the flexible ring connectors with fingers which are also large area.

What does this do for you? As an example I quote again from F.C. Jones Handbook, "The 6146 is not too efficient at 144 mc." "This tube has to be neutralized by series tuning the screen grid lead inductance . . ." His circuit shows a 4 turn plate coil with series tuning, as in a half wave circuit. now look at the 2C39 circuit in Fig. 1. Parallel tuning, high Q, and how is it tuned? With a 25 mmfd capacitor between plate and ground. And what does it do? At half power capability (50 watts) it lights a 25 watt bulb to full brilliance, when driven by, of all things, a standard unmodified Two'er!

It appears that almost any of the 2C39 "family" works fine on 2 meters. I have used 2C39, 2C39A and B, glass or ceramic, the 3CX100A5, the 2C39WA, and the 3X100-A11. In fact, there are probably even more of them I don't know about!

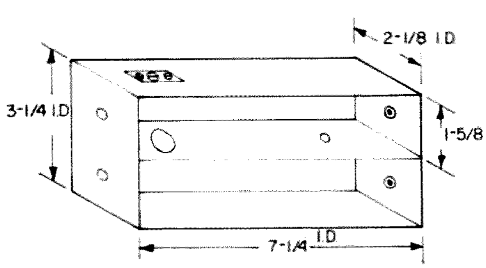


Fig. 1b. Box detail. All copper clad bakelite inside.

Believe It Or Not Dept

B.I.O.N., today, after many years of VHF and UHF and even microwaves, we VHF-UHF amateurs do not have the proper tubes to work with! As you can see from Fig. 1, the grid and the cathode have to "go through each other" to get where they belong. Admittedly, the 2C39 was not designed for grounded grid service. But what else have we got that will do the same job at anything like the price?

I like pentodes too, but not at $20 for the budding young VHF-UHF lad. He's still got to build his power supply. At least with this rig he can step up from a Two'er to 30-40 watts. More with a blower.

Circuit Detail

Basically there are two trough lines: one grid line and one plate line, with a common ground wall in between. This wall has two holes in it, one for the tube, the other for the neutralizing circuit. Electrons flow from the grid to the plate through the first (inside the tube of course), and reversed phase electromagnetic energy (*not* electrons) comes back to the grid through the second hole.

FIG. 2

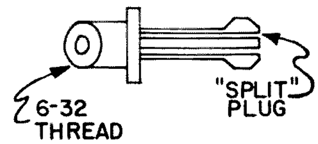


FIG. 3

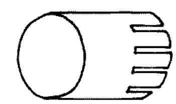


FIG. 4

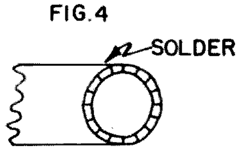


FIG. 5

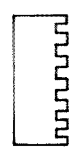


Fig. 2. Filament plug.
Fig. 3. Cathode ring connector. These fingers turn in onto the cathode.
Fig. 4. Side view of grid connector ring and tube end of grid line.
Fig. 5. Plate ring connector. These fingers turn back on the plate ring.

Tube connections may be made with surplus rings, fingers, straps, or "sockets". See Figs. 2 to 5.

The 6 volt filament "plug" in the small end of the tube can be bolted to an insulating plate of bakelite which in turn is bolted to the wall of the cavity. This will hold the tube in place pretty well. Figs. 2, 3, 4, and 5 show some rough details of the connectors that I used. These are obtainable from the Instrument Specialties Co., Little Falls, N.J.

The whole rig appears to be a "natural" for rf grounding. A bypass on the 6 volt connector made no difference to the operation. I put it in anyway. Inductors. Using one inch copper strap creates a high Q for several reasons. First, there is plenty of copper surface for the electromagnetic momentum to work on, and second, this copper is "in line" and protected from radiation by the trough line. Granted a cylindrical cavity where all rf paths are equal length, with 100% shielding, is bet-

ter, but the effort is not justified on 2 meters. Look what you're getting as is! The Q is so high now that large capacitors in parallel can be used to tune to 144 megacycles. High C is of course a standard way of getting rid of parasitics, harmonics, etc., but generally not possible on VHF. It is possible here though, and does a good job. It also makes available low impedance input and output circuits for 50 ohm cables.

The one inch strap lines are grounded for rf at the far end of the trough lines with feed-through capacitors. I didn't have a high enough value so had to add on more discs. Again, not critical. Just don't bypass modulation out of the plate line. That is, in case you wanted to have more fun and use a high-level modulator on the tube later on. As a linear of course, there is no modulation across those bypasses. This is a downright unique feature of this amplifier, it is really uncritical throughout. You can do almost anything to it and it still keeps on working. I even had a contact the other night with no B plus on the plate line, just audio, but that's another story.

The tuning capacitors are Hammarlund 25 mmfd units. They have an additional grounding strap soldered to the rotor spider. It is possible that with a blower and 600 volts, the plate tuning capacitor should have a bigger spacing. We'll check this unit out for the full 100 watts and perhaps a high level modulator to go with it later. Right now it does very fb as a linear.

Neutralizing

If a line (piece of heavy wire in this case) is introduced into the plate tank circuit, grounded at the plate end and open at the other end, it should pick up and produce energy out of phase with the plate voltage on the tube. It does! This out of phase voltage is sent through the common wall to the neutralizing capacitor Cn which is just about the rated grid-plate capacity of 2 mmfd. That is, the Cn is about .8 to 4 mmfd, and the setting used looks like 2 mmfd. To set this neutralizing capacitor, plug a tuned rf power detector into the plate circuit output jack with the 2C39 filament turned on and plate voltage off, with the Two'er feeding rf (all of its ¾ watt) into the grid circuit. The neutralizing null setting is immediately evident and effective. Remove the detector and plug in a 15 to 25 watt bulb, turn on the plate voltage, 200 to 400 volts, and tune up. With the circuit dimensions as shown you may get some self oscillation but only when you tune the plate circuit near 200 mc. When it's all tuned up and loaded even this disappears. After neutralization as per above, grid current does not vary at all, not even one black lines worth, when the plate is tuned through 144 mc. What more do you want?

Blower

For higher power, if desired, some small holes in the far (cold) end of the plate trough line with a small blower attached and a piece of plastic or cardboard over the top of the trough line should allow plenty of cooling. In fact, the air could be sent through the grid trough line at the same time. Some would circulate anyway through the tube hole.

Operation as a Linear AM Amplifier

Here is where this little powerhouse shines. As a rugged low-cost, non-critical triode, in a highly efficient amplifier, it allows very easy tune up. In fact it should work immediately. It did for me. Granted an AM linear is quoted as being "not quite" so efficient as a class C amplifier but what does this difference amount to anyway? RCA transmitting tube handbook says "The efficiency varies from approximately 33 per cent for an *unmodulated* carrier (who needs one) to 66 per cent for a fully modulated carrier." You want more than 66% efficiency on 2 meters? It will cost you a little more in money, time, and effort.

Furthermore let's say you use a converted old TV power supply. I found a half dozen of these you know where! If you're that fussy, go to the local TV repair and sales shop with a few dollars in your pocket. But why pay money for them?

New Gimmick Dept

We claim a first here (until someone shows up with a copy of Sleeper's Radio, 1932, with one in). This is the use of grid rectified bias for a linear. The simple gimmick is a large, really large capacitor, of several hundred mfd (not mmfd) across the grid resistor. This provides the "stiff" bias recommended for use with linear service, and needed. Without it you get downward modulation. With it you can get upward modulation and the difference in audio is quite noticeable. I checked many times, here, and on the air, between battery bias, (ideal) and the one shown in Fig. 1, and so far no one has been able to detect any difference.

Incidentally the 2C39 grid is so designed that no protective bias is needed in case of excitation failure (such as the Two'er stopping operation). Be careful of this with other tubes. Some, like the 811 types, are so designed that they take very little mils when not biased.

Other tubes will run away and that's that. So in this circuit the cathode is grounded both for rf and for dc. Without bias of any kind, the 2C39 takes about 90 miles at 400 volts on the plate. With 500 to 600 it may need a little protective bias.

Cable Matching

With the circuit as shown, matching between the Two'er and the linear amplifier is pretty good. You may have to retune the Two'er plate output circuit, in combination with CI and C2 for maximum grid mils. I found around 20 to 30 grid mils, with a maximum of 40 without any grid resistor. Do not run the amplifier that way. After preliminary tune-up, recheck the neutralization. Do this also after final plate tuning. In fact, do it several times. Gradually all adjustments, Two'er tank, CI, C2, C3, C4, and Cn will come into line. This is recommended in the handbooks incidentally. It is also the natural way to do it.

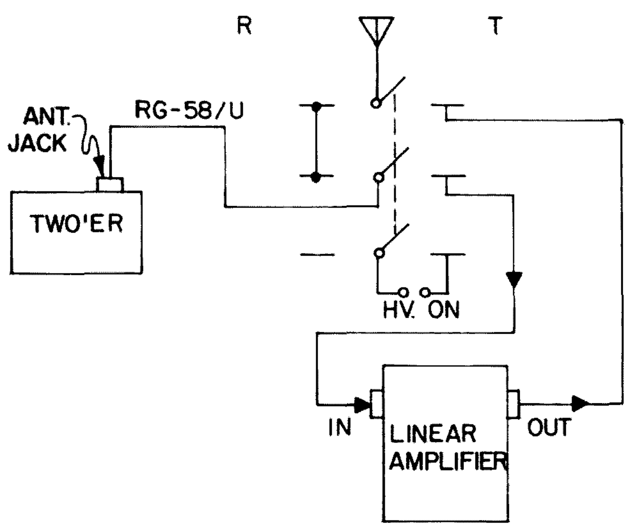


Fig. 6. Note: This is a temporary circuit that requires both switches to be thrown.

Switching

For the moment we will leave you on your own with switching ideas. A good antenna change-over switch has been rebuilt for use on 432 mc and works good there, so it has to work good on 2 meters. An ordinary porcelain wafer switch was taken apart and a "ground plane" of copper-clad bakelite installed very close to the back of the wafer. RG-58/U cable is cut close and installed on this ground plane also. A simple possible diagram of send-receive switching is shown in Fig. 6. This is with 2 switches to throw. A more automatic job (one switch to throw) would put a sensitive relay ($1.95 Radio Lafayette) in, or on, the Two'er, controlling an exterior relay on the amplifier.

On The Air Tests

On the bench with tuned diode detector, transistor audio amplifier, and "Hi-Fi" padded earphones it sounded good. It sounded even better than the Two'er driving it! There could be sound reasons for this possibility, but at least the modulation of the Two'ers is plenty intelligible as is, as far as voice goes. With still no modification of any kind to the original Two'er kit, built by someone else, and putting out at the most ¾ of a watt, I plugged it into the rf input phono jack of the linear amplifier. Into the output jack went my favorite test antenna, the little 2 over 2 four element, the same one I use mobile on the car. It barely clears the roof top of the house here, in fact, does not clear a chimney top mainly because I have a 14 element 432 mc beam on top. Ground level here is only 100 feet above sea level. So, thinking "what have I got to lose", I called a CQ. By 8:30 pm had worked six stations with plenty of carrier, stability, and modulation checks, particularly the last. Varying both the bias and the plate voltage while on the air did not affect the modulation adversely. Evidently that easy method of obtaining linear bias works fb. In one test an S unit was gained on the distant receiver (31 miles) by going from 80 mils at 400 volts to 100 mils at 500 volts, 50 watts. So what if S meters aren't always exactly db power meters? Sounds good to hear it anyway.

On the subject of power, not yet having a blower on the 2C39, and feeling the hot air coming up from it into my face as I manipulated the various switches on the bench, I ran it most of the time at about 30 watts input and about 15 watts out. With exception of one or two step ups to 50 watts just for fun for a minute or so. For all I know the 2C39 might take the 25 watts dissipation without a blower continuously, but I love those tubes and only have about seven of them on hand here right now. Am getting real interested in putting a blower and 100 watts on it! Still driven by that Two'er!

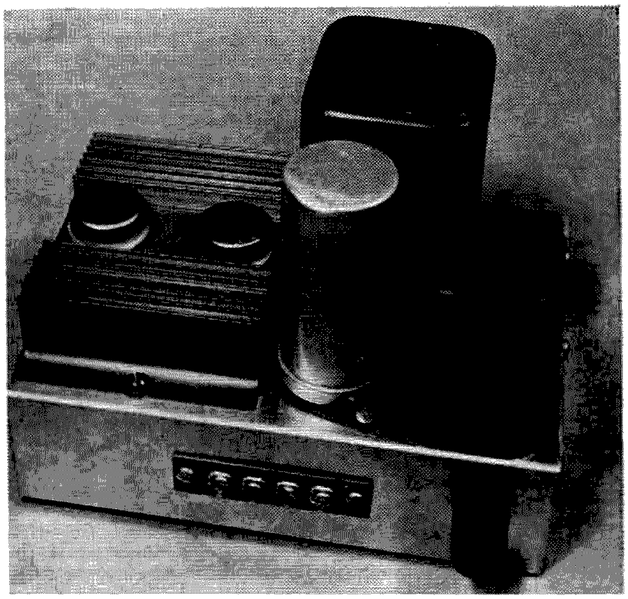
Modulation reports were good: "Could not tell it apart from a Two'er"; "Quality is tremendous"; "Modulation real nice sounding. Very interested in how you connect it to the Two'er".

. . . KICLL

There is an error in the schematic of the linear on page 8 in the September 73. The negative terminal of the 250 mfd grid capacitor should be connected to the junction of the 40 K resistor and the grid inductance.

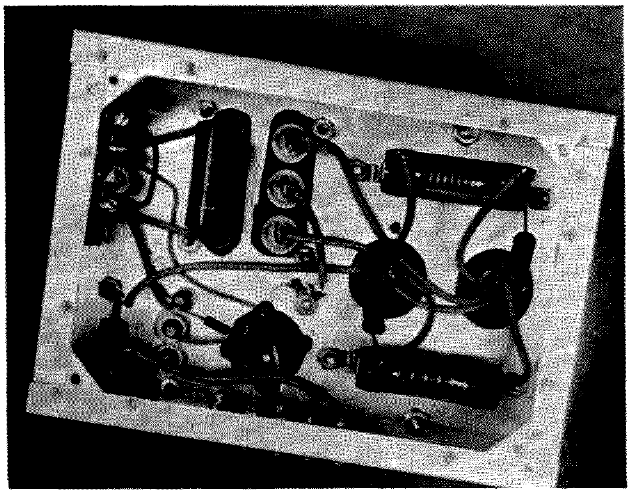
Something for the VW fans.

40 Watt 6 Volt DC to DC Converter



Bruce Pockham W3UWV
Box 383, Route 2
Cockeysville, Maryland

A large number of magazine articles have appeared in recent years on how to design and construct dc to dc converters working from a 12 volt source. Most of these articles have a statement in them somewhere to the effect: 'Of course the supply will work on 6 volts input, but the output voltage will be halved'. If you happen to own an automobile with a six volt battery, or otherwise have to work from a 6 vdc source, these words are not exactly what you have been waiting to read. Furthermore, the output *power* is usually less than half of the 12 volt value when the supply is operated on 6 volts.



I had just such a problem in locating a suitable design for my mobile rig power supply. My car is of foreign make and uses a six volt battery. I was not able to find an appropriate design, so I set about concocting the one shown in the photographs and schematically in Fig. 1.

Fig. 2 shows the pertinent data on this supply. Note that for maximum efficiency, the supply should be loaded heavily to 40 watts. Heavy loading and maximum efficiency go hand in hand for all dc to dc converters. When the output load exceeds 150 ma, output ceases entirely. When the output load exceeds 140 ma, the converter becomes a cranky starter under load. The practical maximum

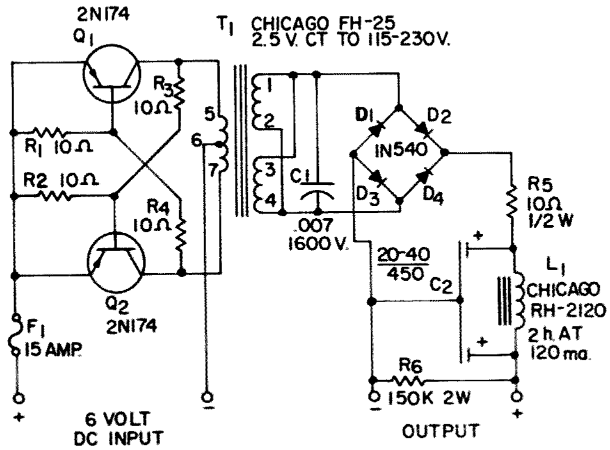


FIG. 1

BILL OF MATERIALS

Q1, Q2	—	2N174 or 2N1358
T1	—	Chicago FH-25 2.5 VCT @ 6.6 Amps to 115-230 V
L1	—	Chicago RH-2120 2 Hy @ 120 Ma.
R1, R2	—	10 ohms @ 2 Watts
R3, R4	—	10 ohms @ 25 Watts
R5	—	10 ohms @ ½ Watt
R6	—	150K @ 2 Watts
C1	—	0.007 mfd. @ 1600 V
C2	—	20-40 MFD @ 450WVDC
F1	—	15 Amp SloBlo FUSE
D1-D4	—	1N540 or equiv.
Heat Sink	—	VEMALINE 6071-4BB or DELTA NC-421
Chassis	—	5 x 7 x 2 Aluminum

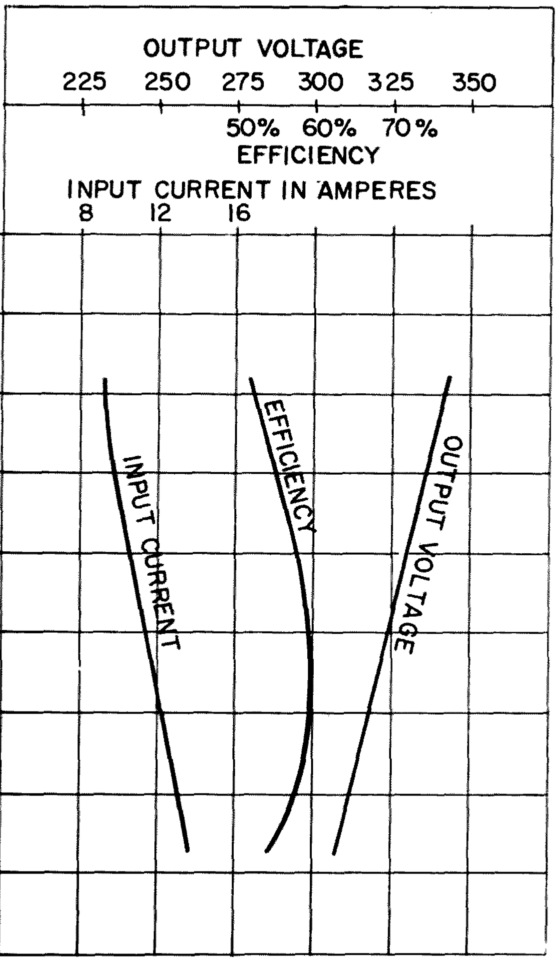


FIG. 2

load should be considered to be 130 ma. It is entirely probable that the use of another type of transformer will change these basic characteristics somewhat.

The transformer I used is rather expensive and frankly, any 2.5 volt at 5 ampere center-tapped filament transformer would probably be alright to use. Because of the type of steel in these transformers and the primary inductance (about 5 mhy), the frequency of oscillation ranges from 70 to 100 cps.

Use No. 14 gauge stranded wire for hook up to avoid excess voltage drops. Use a good heat sink to keep the temperature of the transistors to a respectable value. Do not depend on the 5 × 7 × 2 inch chassis to provide a suitable sink . . . it won't. With the heat sink specified, the transistors never get more than warm to the touch.

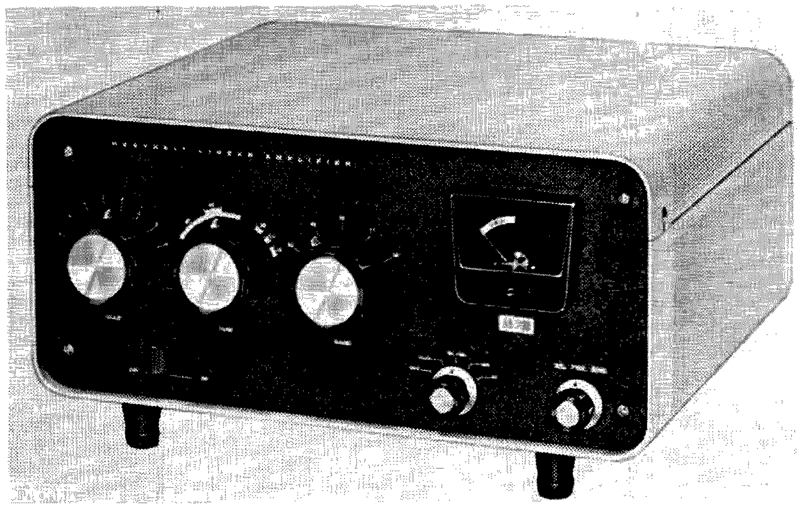
Mount the components and, in fact, the supply itself where there is some air circulation.

Unlike the authors of 12 volt converter articles, I will close by saying; of course this supply can be connected to 12 vdc, but it will cook the wax right out of the transformer.

. . . W3UWV

A test report:

The Heath SB-200



Charles Leedham WA2TDH

There comes a time in every ham's life when the siren call of power is heard, pegging the meter and coming in Q5. It has been beckoning to me, lo these long years, but I had always managed to resist it. Going along with the theory that good signals can be got out with low power, tinkering, and a dash of cunning, I have put in my QRP apprenticeship. I have tuned lines, wrapped baluns, trimmed elements, tapped loads, climbed towers. I have put up beams, ground planes, coaxials, quads, dipoles, long-wires, inverted V's, inverted V beams, and just about every other kind of antenna that will conceivably fit on an apartment house roof.

Even operating from one of the world's rottenest locations—midtown Manhattan—I have managed to put out a respectable signal, getting just about as much oomph as could reasonably be gotten out of a given small input. But when the real test came, getting through in the clutch to the good DX or holding up through the QRM for a phone patch, it was never quite enough. Know the feeling? Ever have your little peashooter trampled to death by the hob-nailed boots of a kilowatt just when you were about to snag that little S2 DX station? The high-power bug was nibbling, and finally it bit, and hard, when the ads first appeared for the Heath SB-200, an incredible KW on CW and 1200 PEP on SSB, and all for only $200. It was just too much to resist.

From the beginning, the SB-200 is an impressive little package. Two packages, rather, because the massive transformer is mailed in a separate small box of its own—presumably because it is so heavy it would smash other components, however well packed, to flinders if it were packed in the main box and that box got joggled much in the post. The major components themselves are a pleasure to unpack and contemplate because you can almost feel all that high power surging through them.

In construction, the linear is straightforward and easy, I didn't keep track, but it was something like ten or twelve hours, and this of very slow, very careful construction. I had no desire to run an unsuccessful smoke test at 2,400 volts, and so checked and rechecked every step. The only point I found that requires any watching at all is the fact that a small coax cavity and driver element (for the SWR bridge) are installed inside the back apron towards the end, and after a number of wires have been laid in the same general area. If you've ignored the manual's earlier instructions about routing those wires, you might have considerable trouble getting the cavity in place. It is a minor point, and if you follow the manual carefully, won't bother you at all.

The power supply section is a breeze. Sixteen silicon diodes, six filter capacitors, plus equalizing and bleeder resistors all slip into a circuit board, leaving nothing much else to do in the power section but put in that husky transformer and hook a few leads to the rest of the unit.

The rest of it goes right along smoothly. Then at the end, there are exactly two resistance checks to make before putting the linear into operation. Heath has prudently avoided any voltage checks, confining itself to repeated warnings throughout the manual on the lethal potentialities of 2.4 kilovolts, and supplying nice red Danger stickers to be put here and there. If you've never handled high

voltages before, this is no time to start—and in any case you won't have to, because the thing works flawlessly. Screw on the top plate of the heavy shielding, drop the hinged top of the cabinet into place, hook it up to your exciter, and you're in business. No tuning of coils, no fussing, no neutralizing, no nothing. Just power.

In circuitry, the SB-200 is only a little more complicated than an electric light. The signal from the exciter comes in through pre-tuned input coils for each band (80 through 10) and is applied straight to the cathodes of the two paralleled power tubes running in grounded grid configuration. These are either 572-B's or T-160-L's. It matters not at all which tube you get, for they are identical tubes except for name.

Input of the SB-200 is a full, round kilowatt on CW and 1,200 watts on sideband. Input drive required to reach full output is 100 watts, easily available from most current exciters, and naturally enough supplied by Heath's companion transmitter/exciter, the SB-400. input impedance is 52 ohms, and the input itself is so broad-band that no tuning is required there. Output is 50 to 75 pi-network, and Heath strongly recommends not working into an SWR of more than 2:1. You can talk on SSB from now until next week, pausing only for breath, and not overheat anything, and hold the key down for up to five minutes, so no fear of blowing something if it takes you a little long to get tuned up. Especially since tuning is a matter of five to ten seconds once you know which knob is which.

There are three hook-ups to the exciter—ALC from linear to exciter, the rf cable, and one for carrying a grounded condition to the linear relay when your exciter relay closes on transmit. The fourth hook-up is to the wall, and you can take either 120 or 240 volts to make the SB-200 work. The primary of the power transformer is split, and a simple change of bridging connections inside the linear allows you to change your power source if you want to—and the connections are made to screw terminals, not soldered, thus making power changes almost instant. Peak power draw is 16 amps at 120 volts, 8 at 240. I've got the thing hooked up to 240 volts from an air-conditioner outlet near the operating bench, figuring that 16 amps on the single 120-volt line in the room would be a bit much, considering the fact that everything else (transmitter, receiver, lights and such are already quite enough. What will happen come summer I'm not at all sure. The line cord comes with a three-prong grounding plug, plus an adapter for a normal wall plug if your house or apartment isn't equipped with grounding sockets. But be sure you use the grounding connection of that adapter, onto the screw of the socket! That kind of voltage is nothing to have around ungrounded. Or, if like me, you plan to plug it into a 240-volt source, make sure you have a proper plug on hand for that socket. Most if not all air-conditioner and other 240-volt sockets take completely different types of plugs, so get one when you put in your SB-200 order, or start looking for one. Then just clip off the plug supplied with the line cord, wire on your new plug (CAREFULLY!) and you're in business.

The linear, incidentally, is not fused but has two button-resettable circuit breakers and the buttons are accessible at the top, after lifting the piano hinged top of the cabinet and respectfully observing the big DANGER label on the shielding. Whether the breakers work or not I couldn't say, as nothing has ever popped—which is quite a good recommendation for the linear. But I imagine they do. There is also very little apparent heat from the two big tubes. They are fan-cooled, and the fan moves the heat out very smoothly, so that a hand held over the top of the cabinet feels hardly anything. Still, heed Heath's cautions about putting it in a well-ventilated area.

Actual operation is totally painless. First, you peak up your exciter using the relative power setting of the linear's meter. Here, incidentally, somebody at Benton Harbor has been doing some good thinking. The meter reads relative power of the exciter when the linear is switched off, and then of the linear when it is on. Also, more thinking—there is an SWR setting for the meter which reads the SWR of the exciter, linear off, or the SWR of the whole affair. With the exciter tuned, it needs only to touch up the tuning and loading of the SB-200, and you're ready to put out those lovely big watts. Switching from exciter to linear is almost instantaneous. Shove the big rocker switch on the front panel and the instant-heating tubes start boosting your signal within two or three seconds. And that's all there is to it.

Operation with this tabletop powerhouse is pure pleasure. I have always stayed pretty much out of the pile-ups in the past, knowing full well that the power boys would beat me out almost every time, and I've settled for working the DX that I happened to hear first and early. But once the SB-200 was in place I couldn't resist the temptation. Within the first few hours of operating, I walked happily

nto three good struggles for some interesting)X, and came away with the contact. Heh ıeh. Of course, some of the low cunning ıecessarily developed in the years of trying to ;et through with low power helped, but it was he pure brute power of the kilowatt that urned the trick. Things look a great deal dif- erent from behind a kilowatt. Cross my heart, 'm not going to trample my way into any nore pile-ups, but better you should get an ;B-200 just in self defense in case I weaken.

The SB-200, I think, is going to be one of the ʼery hottest items Heath ever came up with, ınd they have a long history of some very ;ood stuff. I haven't had a moment's trouble rom it, from the first time I hit the switch. The ›utput is clean, and on-the-air reports from ome very critical people have been universal- y excellent as to quality. And no TVI, either, o far as I know. And the price! Any time ʼou can buy yourself one thousands watts for ;200—that's all of 20c per watt—that is the ime to break open the piggy bank. I hear hat orders for the SB-200 are piling up like ıutumn leaves out there in Benton Harbor, so ›etter get yours in quick. Very highly recom- nended.

. . . WA2TDH

Solution to Ham X-Word

T	R	A	N	S	D	U	C	E	R		
R	A	D	I	O		F			E	N	D
A		R		L	C		H		L		I
P	A		C	D		A	R	R	A	Y	S
E	V		C	E		E	D	D	Y		S
Z	E	N	E	R		C					I
O					P		C	H	I	R	P
I		B	I	A	S		L	U		P	A
D	O	U	B	L	E		A	M		T	T
A		R		A		F	S		R		I
L	C	R			T		S	E	L	F	O
		S	A	T	U	R	A	T	I	O	N

Answer to question on p. 65: NE-2

E. Robson 5Z4ERR
P.O. Box 30077
Nairobi, Kenya

How To Fish For DX

You don't have to be a rich man to go fishing for fish or DX. The urchin is often the one who gets home with the biggest trout, caught with a worm on a bent pin.

I can rightly claim to know most of the DX boys and whilst many of the past and present honor roll experts have superb equipment now, they certainly did not to begin with and like any hobby you gradually improve and accumulate your equipment.

I joined the Phone Honor Roll in April 1948 and like W1FH and W2BXA I'm still in it and during this time have discussed "Fishing for DX" with all types including the top ten and would like to pass on this collected information and advice to those who delight in collecting new countries.

Many of my friends were hams who came to Kenya for a three year tour—worked 100 countries or more and then went on to Uganda or Tanganyika or the West Indies to work a succession of new "100" DX Certificates. Total value of equipment carried usually valued at $300! But like all hobbies, if you can afford good equipment—buy it.

To get into the Honor Rolls—you require certain essential equipment admittedly—such as

1. A first class, properly calibrated receiver—stable and sensitive.
2. A good monoband beam or quad—at least three elements for 14 megs.
3. An ssb Transmitter 150 watt PEP.

Further down the list—whether you make or buy them, come

1. A PA to follow the above Tx.
2. Antenna rotators and indicators and more antennas.
3. SWR Bridge with Input/Output meter, FS meter, etc. are all fun to build and useful.
4. If you have a permanent location a tower is well worth making or buying. Get a minimum height of forty feet and a steel 2″ mast through the top will add on ten feet. Your tower will last longer than you, and requires no upkeep and is easier to climb.
5. A workshop bench and tools.

To the above desirable things which help so much and which help you to see at a glance if your 'power' is going out and in which direction I would add a really comfortable chair and operating bench.

Whether you buy or build it is queer how one guy buys a good Rx and uses any old antenna and another does the opposite.

Even lesser ills such as an uncomfortable chair, a table too high or low, poor lighting, contribute to tiring a chap, so do too many switches, just out of reach.

Having got your equipment up to the best standard you can or will afford, comes the question of how to use it.

Check that the antenna system is all bolted down well and all joints and connections weatherproofed and before you leave it, borrow a SW bridge and get the antennae impedance matched up to the Tx. Then unless you have a really modern Rx it will pay you to match the Rx up to the 52 ohm feeder. My old 75A1 was miles off 52 ohms.

Now you are ready—with a good setup but there is a certain amount of thought and know how, rules, habits, customs and methods which are worth studying.

In the front end of your call book you will find a list of countries with plus or minus GMT.

It is labelled:

"Standard Time throughout the World".

Most of us don't know it is even there. Yo are looking for some country, fine, you can spend your evenings or week-end afternoons searching but it is no good looking for a country at 3 a.m. *his time*. It is his time tha matters and you must arrange to look for hi in the evenings—his evening time, not yours. On Saturdays and Sundays look for him i the afternoon and mornings but *his* afternoon time. Study his habits and if you know somebody who worked him collect the times GMT when he was active.

You then get a pattern with perhaps a mos active time of 1900 GMT on Fridays or Saturdays. Begin to look for him a little befor and you have also got his usual frequency, sc listen and try and get in quickly before th kilowatts get busy. You have got 10 minute or if lucky 20 minutes at the most befor the frequency gets swamped. If you are luck and have two receivers put your ground plan on one and use *if* for casual searching. You may miss a weak DX station if your quad o

beam is a good one and highly directional. When you have found the station, turn your beam onto him and "blast him" as they say. Both Rx must be coupled up to mute and to short out at the antenna terminals.

When you find him, you may find he is working on 14150 and listening on 14270 upwards. Put your beam and Tx and Rx onto 14270 and the other Rx on the ground plane onto his frequency and listen to him talking to find out when to call him. Soon you will catch the station talking to him and vfo onto that station or if very crowded—just off frequency—a few kcs only.

By keeping an eye on both him and the station he is working you can move in quick with split second timing. Slip in your own call sign quickly—once or perhaps twice, talk quickly and clearly. The split second timing is important, most of these expedition hams are very good operators and appreciate good timing and short calls and know their own call signs quite well—it's your call sign they want. During a QSO at a "change-over-to-you" it is quite legitimate to slip in your call—short and quick—and if he says "stand-by" just wait and he will always, nearly always, call you in.

I have been at "both ends" VQ1, VQ3, VQ4, VQ9, giving ssb for the first time in some cases and speak from experience. The U.S.A. hams and the U.K. boys were the best operators—listen to Honor Roll gang for tip-top know-how and slick operating. You never hear them calling long and loud or persisting in calling when they are not sure if the DX is talking or not. They don't hog the frequency and yet they always get their man—in and out quickly to make way for the next man. After getting him, move right off the frequency at least 10 kcs up or down and if you are likely to be called by someone, say as you finish 73's and "moving down 10 kcs".

Bad operating is a pain in the neck and slows up everything. Don't ask the guy for his QRA—you'll hear him give it sooner or later and you can get it from someone else and don't tell him all the details of your shack—get off his frequency and keep it short if there is a queue waiting.

Very often, slipping in quick calls, you will be heard by other stations who will mention it to the DX station as they sign off and you may get a direct call and that's fine, but you may miss the tip-off to get ready with *only one* Rx.

Getting quickly off the mark and getting in quickly is essential. You can say "he will be on the whole week". "I'll look for him later" and you may be right and work him easily when the heat is off but my motto is work him as soon as possible, generator trouble, loss of voice, failure of equipment, have often terminated or handicapped expeditions.

Your manners? Tut! Tut! Listen to the topliners. Most are polite and a pleasure to listen to—very few lids or hogs among these chaps and someone usually puts them in their place if they get too excited and hog the frequency.

It is no good calling the station until you can really hear him. Sometimes the strain and excitement gets the better of the DX hunter and we occasionally hear "I think you came back to me OM—you are 3 & 3—lots of QRM" etc., meantime the DX is talking to someone else. These imaginary QSO's are rather stupid even if they are genuine errors.

Wait and listen or try later on when the band is more open to the DX area.

You will find others keen on DX and you can subscribe to various clubs who air-mail out a weekly bulletin of DX.

As soon as hams know you are collecting countries they will drop in on the frequency to discuss DX with you. You can keep up-to-date and on the alert by listening to many people like PY2CK, 4X4DK, TI2HP, W4ECI, MP4BCC, MP4BBW, who are keen on DX and sponsor DX in some cases. I get most of my help and news from my rivals and I try and give them as much news and help as I can—it's good fun but take it easy and live and let live. Take your holidays and go travelling with the family and work in the DX the best you can without penalizing your family and friends and in case you don't know it—yourself in the long run.

On QSL's—if you are in a hurry send an addressed envelope with enough coupons for air mail postage. You can put U.S.A. stamps on self addressed envelopes if the DX station has a U.S.A. QSL manager. Buying stamps is much cheaper than buying 6 or 7 coupons which is necessary for 1st class air mail in many countries.

If you are a foreign country like me you can, when corresponding, economize by writing and using aerogramme forms at six pence and tacking a 25 cents U.S.A. air mail stamp inside for return postage and perhaps a smal gummed self addressed slip which makes i easier for the QSL manager. Always quot your QSO's in GMT. I shall always remembe Dick KV4AA giving me hell about it an saying "I ought to know better". How righ he was. Checking up thousands of QSL's fo Danny would drive you nuts if all QSL's use their local times.

I cannot close this message without allusion to Gus. I hope for the sake of posterity someone has taped 30 minutes of Gus working the pile up on CW and SSB. Some magazine should rent out a tape to all those about to embark on DX expeditions on how to handle a pile up.

To listen to Gus operating is to listen at the feet of a master of DX operating. I shall always remember him saying, "Ok, Ok, Ok, chaps all stations up-ten—all stations up-ten".

The heavy metal brigade moved up ten and called long and loud and I heard Gus mutter "that will take care of the lids" and he proceeded to pick off stations at 3 a minute anywhere except ten up. Work it out. I was trying to work Gus but I collapsed in laughter as soon as I worked it out.

If you are a bit DX yourself you must learn to control the pile ups, right from the start and keep a firm grip. It's kinder and quicker and is appreciated by the good operators.

If you are at say VQ9 for a spell you will get perhaps 500 calls on your tail within minutes.

Just say "W1's only, between 14270-80" and then W2's and so on. They will be delighted and quietly wait their turn (most of them). The only ones to grumble will be the W9 and WØ especially if the band weakens, in which case only work a dozen of each. Don't give your QRA name, Rig, etc., except occasionally—let them listen and find out. You can work at peak openings, three a minute on SSB if you cut out the trimmings—treat it like a contest.

I know it's a chore and lots of people don't like rubber stamp QSO's but there are plenty who do and are grateful for a new country and 20 seconds of your time. To the persistent rag chewer just say "can't stop 'scuse me' " and go ahead with the next one. I have never heard Gus get ruffled or cross—always even tempered and smooth and efficient but he controls the band like an astronaut. Comparisons are odious but I must also mention WØMLY Dick, Danny, Angus, and other experienced astronauts—it's the only word for them! Dick, Angus and Gus have broken into a QSO, apologized for the interruption "just wanted to give you a new country, Robby, hope you don't mind" and then literally disappeared under a welter of QRM, but only for a moment. They wait and they dictate their terms to the mob and are in control in a few minutes. That last method of working a new country—being called by one—is of course the best way of all, why don't you try it!

The old hands who may have read so far will I'm sure, be agreed on these DX problems and the beginner may learn a few things but there are still several things we can do to help.

1. Listen before you call CQ and rag chew, and keep away, when rag chewing, from DX activity and the popular DX sections of the band.

2. 14100 to 14130 is virtually ssb plus ssb DX. Don't rag chew just there, move up to 14160 and 14200. The am boys are fading out but respect the die hards. There is a core of them between 14130 and 14160.

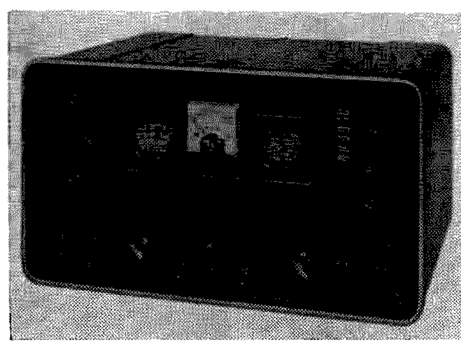
3. On 14200 and 14250 a lot of U.S.A. am hams are still found—let them alone and don't go down there on ssb too often—just yet.

4. 14300 and area is still quite a DX spot and so is 14270. Why not contact your pal and move up 14330 say. You'll notice I don't mention other bands on which these problems don't arise often and have solved themselves but 14 megs is a precious band and needs care to keep it so.

5. When you cross-talk, across town or state why not move onto 28, 21, or 7 or 3.5 megs or VHF, whichever suits and keep off 14 megs.

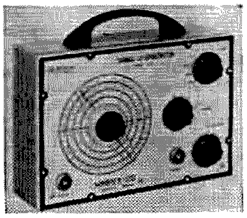
6. Some U.S.A. DX Clubs have "VHF call links" to swap DX news and information. That is smart and thoughtful, and they help each other to net DX fish. . . . 5Z4ERR

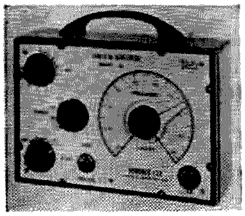
New Products



HQ-145AX

Hammarlund has announced a new version of their very popular HQ-145A, the general coverage 540 kc-30 mc receiver with calibrated electrical bandspread on 80-40-20-15-10 meters, dual conversion above 10 mc, six position crystal filter, slot filter, etc. The new "X" model gives a choice of 11 crystal controlled channels selectable from the front panel for any frequency in the receiver's tuning range. This will certainly be of interest to amateurs who are interested in such fixed channels as MARS, CAP, WWV, CHU, and regular nets. Price $349. Info? Write Hammarlund, Mars Hill, N. C.





New Path Signal Generators

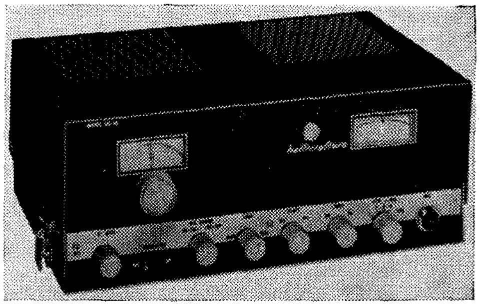
Any one who works with electronics knows how necessary signal generators are. Path products have announced two very nice generators made by the famous Nombrex company of England that will cover the test and experimenting needs of virtually all hams (not to mention labs, service technicians, field engineers and hobbyists). Both are light, compact, durable and stable. Both operate from common 9 volt batteries and are in handsome steel cases with aluminum panels. They are wired, tested and calibrated at the factory, yet sell for no more than tube type generators. The prices include test leads, instructions and battery. Service is provided under the guarantee of Path Products. Be sure to notice the wide coverage of both generators. For information, write to Path Products Corp., 55 Halley Street, Yonkers, N. Y.

Model #27 All Transistor Wide Range RF Signal Generator

Price — $36.25
Range — 150 kc to 350 mc, continuous tuning.
Accuracy—better than 2%.
Modulation — 30% from internal 400 CPS osc.
Outputs — 1) RF: 0.05 volts into 75 ohm load.
2) AF: 1 volt, 400 CPS, sine wave.
Frequency stability — less than 0.2% max. frequency shift due to changes in load; less than 0.4% with battery at 7.5 volts.
Dimensions — 6⅝" x 4⅝" x 2⅝".
Weight — less than 2 pounds.
Controls — tuning, range, off-RF-modulation-AF, RF attenuator, RF out, AF out.

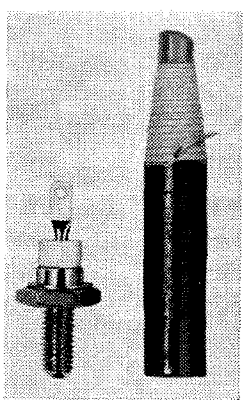
Model #63 All-Transistor Audio Signal Generator

Price — $59.25
Range — 10 cps to 100,000 cps in 4 bands.
Outputs — 1) sine wave.
2) triggered square wave.
Accuracy — within 5%, not affected by battery voltage.
Output level — 1 volt p-p ± 1 db; automatic thermal control.
Attenuators — 3 position step attenuator, continuous variable attenuator calibrated in mv; accurate within 3% of output voltage.
Dimensions — 6⅝" x 4⅝" x 2⅝".
Weight — less than 2 pounds.
Controls — frequency, sine-square wave, range, step attenuator, mv attenuator, output jacks.



VHF Transceivers

Hallicrafters has announced the SR-42 for two meters and the SR-46 for six meters. They both have nuvistor front ends, superhet receivers with dual conversion and a crystal controlled second oscillator, automatic noise limiters, S-meters, and push-to-talk. Both are powered by a combination 115 vac and 12 vdc supply. Both are reasonably priced at $189.95. Further info is available from Hallicrafters, Chicago, Ill. 60624.



New Amperex Varactor

The Amperex H4A varactor with a cut-off frequency of 60 Gc (60,000 mc), offers high power handling capabilities due to its high breakdown voltage of 175 volts and low series resistance. As a frequency tripler the H4A can deliver 25 watts into a 50 ohm load at 144 mc with an efficiency of 60% and 13 watts at 432 mc with an efficiency of 50%. The price is half that of a 5894 or 2C39 and no socket, external power or modulator is required. See October 73 for more information on these fabulous varactors.

Application Report #S-121 "Frequency Multipliers with Varactor Diodes" is available to designers. This report covers theoretical considerations of doublers and higher multipliers and as with all of the excellent Amperex reports, also discusses a number of practical circuits with circuit diagrams, graphs and photos of layouts.

More information can be obtained from Amperex Semiconductor and Receiving Tube Division, Providence Pike, Slatersville, R. I.

Index to Articles in 1964

CAVEAT EMPTOR?

We've had so many requests from 73 readers for a want ad section that we're starting one—against our better judgment. After all, we're dreadfully overworked now and are bound to have even more of a headache handling all those tiny ads. But you say you want it, so please follow these instructions when you submit ads:

- ★ Price—$2 for non-commercial ads; $5 for business ventures. No display ads or agency discount. Include your check with order.
- ★ Type copy on standard size paper. Phrase and punctuate exactly as you wish it to appear. No all-capital ads. Include your signature with order.
- ★ We can only accept ads related to ham radio. We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.
- ★ For $1 extra and an SASE, we can maintain a reply box for you.
- ★ We cannot check into each advertiser, so Caveat Emptor . . .

QSL'S? WPE'S? CB'S? Personalized made-to-order one-day service. Largest variety of samples 25c. DeLuxe 35c. (refunded) Sackkers, W8DED, Box 218, Holland, Mich. (Religious QSL samples 25c.)

Clegg 99er in excellent condition, $99. Box 154, 73 Magazine, Peterborough, N. H.

QSL's $1.75/100. Eye-catching, different. Sparkling gold or silver printed on six exciting Hi-Gloss cardstock colors. Samples 5c. Nu-Print, Dept. A. 322 Page Boulevard, Springfield, Mass.

Picture QSL Cards of your shack, etc. made from your photograph, 500 $14.50. Also unusual no-picture designs. Samples 20c. Raum's, 4154 Fifth Street, Philadelphia, 19140

SPECIAL in new and used amateur gear. We have it at an exceptional savings. Write or call Bob Grimes, 89 Aspen Road, Swampscott, Massachusetts, 617-598-2530.

Printed circuit boards. For many different projects. Hams, Experimenters. Send for catalog 10c. Dealer inquiries invited. P/M ELECTRONICS. Box 6288 Seattle, Washington 98188.

CHRISTIAN Ham Fellowship now being organized (non-profit undenominational fellowship organization for hams). Christian Ham Callbook $1. Write Rus Sakkers, W8DED, P.O. Box 218, Holland, Michigan.

CENTRAL ELECTRONICS 100V AND 600L LINEAR, good condition, both for $650 cash. William Kolouch, Jr. K1DZI, 509 Highland St., Wethersfield, Conn. Tel. 203-529-4433.

Globe Sidebander package: Includes Globe VOX 10, WRL 755A VFO, a steal at $59. Tecraft CC144 6 tube 2 meter converter. Less tubes and crystal, $10. 100 kc calibrator for NC 300, $10. LW 2 meter converter, $5. Transcom 10, 10 meter mobile transmitter-converter, $10. AXT-2 TV xmtr. New $15, partially converted, $12. Include postage. WA1CCH, 1 High St., Peterborough, N. H.

INDEX TO ADVERTISERS

Propagation Chart

EASTERN UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	7	7	7	7	7	3	3	3#	7#	14	14	14
ARGENTINA	7*	7#	7#	7	7	7	14	14	14	21	21	14
AUSTRALIA	14	7#	7#	7#	7	7	7	14	14	14	14	14
CANAL ZONE	7	7	7	7	7	7	7	14	14	14	14	14
ENGLAND	7	7	3	3	3	7	14	14	14	14	7#	7
HAWAII	14	7#	7	7	7	7	7	7#	14	14*	21	21
INDIA	7	7	7#	3#	3#	7#	14	14	7#	7#	7#	7
JAPAN	7*	7#	7#	7	3*	3*	7	7	7#	7#	7#	14
MEXICO	7	7	7	7	7	7	7	14	14	14*	14	14
PHILIPPINES	7*	7#	7#	7#	7#	7	3	7	7#	7#	7#	7
PUERTO RICO	7	7	7	7	7	7	7*	14	14	14	14	14
SOUTH AFRICA	7	7	7	7#	7#	7#	14	21	21	14	14	7*
U. S. S. R.	7	3*	3	3	7	7#	7*	14	7*	7#	7#	7
WEST COAST	14	7	7	7	7	7	7	14	14	21	21	14

Good: 3-5, 8-10, 12-16, 21, 22, 24-31
Fair: 1, 2, 6, 11, 17, 19, 23
Poor: 7, 18, 20
Es: 4, 8, 15, 16, 26

CENTRAL UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	7	7	3	3	3	7#	14	14	14*
ARGENTINA	14	7#	7#	7	7	7	7*	14	14	21	21	14
AUSTRALIA	14	7#	7#	7#	7	7	7	7	14	14	14	14*
CANAL ZONE	7	7	7	7	7	7	7	14	14	14*	14	14
ENGLAND	7	7	3	3	3	7	7	14	14	14	7#	7#
HAWAII	14	7#	7	7	7	7	7	7	14	14	21	21
INDIA	7	7	7#	3#	3#	3#	3#	7*	7	7#	7#	7
JAPAN	14	7#	7#	7#	3*	3*	7	7	7	7#	7#	14
MEXICO	7	7	3	7	7	7	7	7	14	14	14	14
PHILIPPINES	14	7#	7#	7#	7#	7	3	7	7	7#	7#	7#
PUERTO RICO	7	7	7	7	7	7	7*	14	14	14	14	14
SOUTH AFRICA	7	7	7	7#	7#	7#	14	14	21	21	14	14
U. S. S. R.	7	3	3	3	7	7#	7#	14	7*	7#	7#	7

J. H. Nelson

WESTERN UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7*	7	3	3	3	3	3	7	14	14	14*
ARGENTINA	14	7#	7#	7	7	7	7#	14	14	21	21	21
AUSTRALIA	21*	14	14	7#	7	7	7	7	14	14	14	14*
CANAL ZONE	14	7	7	7	7	7	7	14	14*	21	14*	14
ENGLAND	7	7	3	3	3	7	7#	7#	14	14	7#	7#
HAWAII	21	14	7	7	7	7	7	7	14	14	21	21
INDIA	7#	14	7#	7#	3#	3#	7	7	7*	7#	7#	7#
JAPAN	14	14	7#	7#	7	7	7	7	7	7#	7#	14
MEXICO	14	7	3	3	7	7	7	7	14	14	14	14
PHILIPPINES	14	14	7#	7#	7#	7	7	7	7	7#	7#	14
PUERTO RICO	14	7	7	7	7	7	7	14	14	14	14*	14
SOUTH AFRICA	14	7	7	7#	7#	7#	7#	14	14	14*	14*	14
U. S. S. R.	7#	7	3	3	3	3#	3#	7*	7	7#	7#	7#
EAST COAST	14	7	7	7	7	7	7	14	14	21	21	14

Very difficult circuit this hour.
* Next higher frequency may be useful this hour.

73

FEBRUARY 1965

40c (but worth less)

Amateur Radio

73 Magazine

Wayne Green W2NSD/1
Editor & Publisher

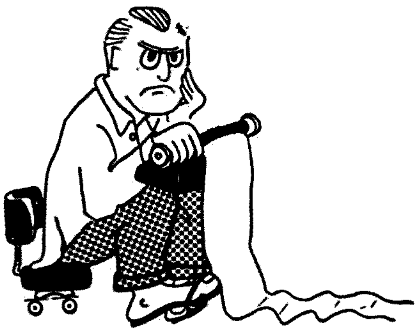
Paul Franson WA4HWH/1
Assistant Editor

February, 1965

Vol. XXVIII, No. 1

Cover by K3SUK

Magazine is published monthly · 73, Inc., Peterborough, N. H. ie phone number is 603-924-3873. ıbscription rates $4.00 per year, .00 for two years, $10 for three ars world wide. Second class post-e is paid at Peterborough, New ampshire and at additional mailing ices. Printed in the U.S.A. Entire ntents copyright 1965 by 73, Inc. ıstmaster: please send form 3579 to Magazine, Peterborough, New ampshire. All those interesting :icles and here you are wasting ur time with the small print!



de W2NSD/1

never say die

Institute of Amateur Radio

During Christmas week I got together with the Directors of the Institute in Washington to review our progress during 1964 and map our course for 1965.

I think that all of us were amazed at how much our small group of less than 700 amateurs had accomplished in one short year. Now, for the first time in history, amateur radio has a bonafide lobbying organization in Washington to represent amateur radio. A Congressional Amateur Radio Newsletter has been established to bring news of amateur radio accomplishments and service to the members of the House and Senate. Amateur radio is now, for the first time, in a position to protect itself from the pressures of commercial and even government interests.

Plans for increasing our effectiveness with Congress were discussed and a preliminary approach to the international promotion of amateur radio was developed.

Considerable concern over the gradual swallowing of the League by QST was expressed and we are intent that this pattern shall not be repeated with the Institute. A study of the current balance sheets of the ARRL indicate that about 90% of the income of the League goes for their publishing business and only about 10% for matters of benefit to the members. This means that about $4.50 of each $5.00 membership/subscription goes for the magazine and about 50¢ for membership benefits. Thus, unless this same pattern is permitted to repeat itself, the Institute should be able to match the current efforts of the League for the amateurs with a membership of about 7,000. For that matter, if we continue to get as much mileage from our income as we have during the last year we may match their efforts with a lot smaller group than that.

But just matching their efforts is not going to do much for the survival of amateur radio, and this is our major concern.

A review of our actual expenses in setting up the Institute, organizing the Washington office, establishing the Amateur Radio Congressional Newsletter, registering with both the House and Senate as an official lobbying group for amateur radio and administering memberships showed that we had spent far less than we had thought possible. We had achieved our first years goals and ended the year with over $3000 in the bank! In view of the savings which had been effected it was decided to automatically extend all Founding Memberships for an extra year and to reduce the yearly dues to $5.00. So many members had asked for some arrangement for a combination membership in the Institute and subscription to 73 that it was decided to accept the two together for $7.00 per year. It was definitely decided not to force 73 subscribers to join the Institute or to force Institute members to subscribe to 73, as is the present case with ARRL and QST.

Clubs

Against my better judgement we're giving such a fabulous deal for clubs that it makes me sick. If your club secretary doesn't write in immediately for full details on how to save money on subscriptions and fill the club coffers simultaneously qualifying 73 as a disaster area for Poverty Corps attention, you'd better take his ARRL pin away and demote him to Sergeant-At-Arms.

Stamp

Perhaps you've noticed that I did not put that crumby stamp on the cover of 73 this month. My postmaster called a few week

before it came out and asked if I wanted him to get any extra copies of the stamp. I enthusiastically told him to stock up heavily for us. Then the thing came out. Very depressing. A pointless design indicative of nothing, printed in embalmer' purple. When the first one came in I sat there and looked at it in dismay. This was it . . . the amateur radio stamp . . . the *only* stamp amateur radio would probably ever have . . . and it was terrible.

Gronouski (PMG) had been turning out some great stamps with his new four color offset press. Purple we got. I was hoping for something nice like a portrait of Hiram Percy Maxim or perhaps a Wouf-Hong. So what do I see? An AM modulation envelope, a Collins knob, and some calibration. Well, they can use the same stamp with a slight word change to commemorate CB.

Microwaves

We have a few good article coming up on microwave gear, but we'd sure like to have a lot more of them. If you're working on ham microwave stuff why not unstinge and turn loose of some of your trade secrets. After all, the worst that can happen is that others will falter along in your footsteps. We pay good like a magazine should.

Draftsmanship

We seem to have more drafting for 73 and some of the books we have in preparation for publication than our present corps of draftsmen can handle. Is there anyone out there with radio drafting experience (and templates) who is interested in a few spare dollars for copious quantities of their time?

Thud

The Christmas thaw which hit New England opened up the road to the VHF shack on 73 Mountain. Val, K1APA, and I gave it a try in the new 73 Mercedes and made it all OK. It was so cold that we zipped right into the house . . . to be met by an equal and identical cold . . . it was 19° in and out of the house. We turned on the electric heater and the two meter rig and soon had the temperature up to a cozy 28°. I tuned two and heard a lot of silence. Hmmm. A short CQ brought an answer from down in New Jersey. I switched antennas and found that the 48 didn't seem to be working . . . the 96 element was doing fine and the 192 element was weak.

Val went out . . . took a quick look and hol-

(Continued on page 88)

Allan W. Crowell WA6OQP
151 Estates Drive
Santa Cruz, Calif.

The Ham and TVI

Cartoons by K3SUK.

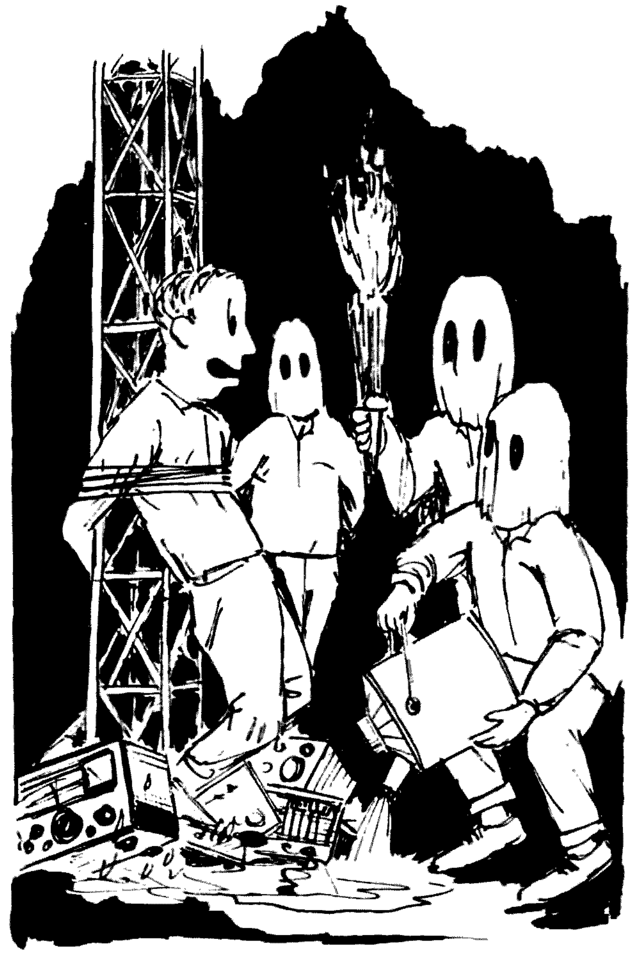
Looking for new fields to conquer? One such area is in improving the relationship between John (or Jane) Q. Public and amateur radio. You can easily get yourself appointed chairman of the local radio club TVI committee. Here is a chance to help both the public and the amateur, and while the pay is low (low? it's zero!), the personal satisfaction of contributing to the public service by solving interference problems can be great. Actually, the designation TVI is a misnomer because it represents only one type of interference in a two way street, interference by an amateur to the public and interference to the amateur by the public (including utilities). It appears in many forms, TVI, BCI, Hi-Fi, CBI, power leaks, and diathermy to point out but a few.

Interested? Curious to know how to go about being a TVI committee? It's really quite simple and there is no magic involved in solving the problems. The solution to each requires the proper handling of several fundamental points. Let's use a hypothetical case as an example of the technical and operational approach. Keep in mind however, that the principles apply to any type of interference investigation.

You are minding your own business at home one night when the telephone rings. It's a poor downtrodden local ham who tells you he has been threatened with bodily harm by a little old lady down the street who hears his voice on her TV set, and if that isn't bad enough, the picture looks like the results of a runaway mixmaster. Your first job is to calm him down if necessary and assure him that you will jump right in and make an impartial investigation of the complaint. Only generalities can be discussed on the phone so make a date to visit his station, and at this time begin filling out your investigaton report. Leave nothing to memory, particularly the technical findings you will uncover. Some report headings are: 1. date of complaint and by whom notified, 2. name, address, and radio call of the alleged offending party (alleged is used here because sometimes the wrong person is blamed for the interference, 3. alleged interfering equipment, including antenna system and block diagram, 4. your technical findings regarding the interfering equipment before and after any equipment changes or adjust-

ments, 5. name and address of the complainant, 6. the actual complaint, 7. type equipment being interfered with including the antenna system, 8. your findings at the home of the compainant before and after any equipment changes or adjustments, 9. your recommendations.

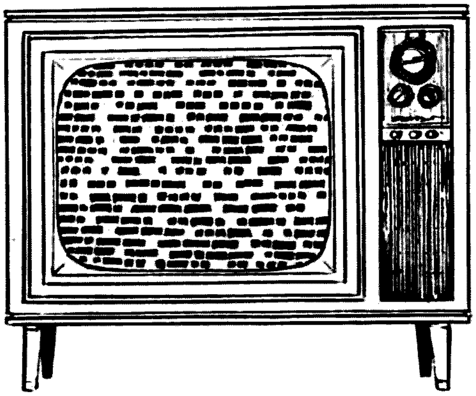
For your visit, bring along several pieces of test equipment (each will be named as needed in your investigation), and a member of your committee. First, both of you should make a careful inspection of the alleged offending equipment and its operation by the owner, but make no changes nor adjustments at this time. Continue notations in your report. You will need two walkie-talkie transceivers, either CB or hamtype to communicate between your committeeman, who will remain at the ham station for the purpose of relaying your ham transmitting instructions, and you while conducting the interference investigation at the home of the neighbors. Here are three very important points which practically guarantee a satisfactory working relationship between you and the public, 1. unless you know the complainant, go alone (two or more unknown individuals suddenly appearing at the front door, especially at night, will probably get no farther and little cooperation relative to solving the complaint, 2. yours is a business visit, so wear a business suit, (this does several things, it impresses the party that you are somebody, and further that you must know your business, and if clothes make the man, it will give you a sense of self confidence in your dealings and explanations, particularly if you are not well received). Personally, I introduce myself, then my role in the television interference investigation committee, its connection with the local amateur radio club, and finally that I've been asked to make an impartial investigation by the amateur involved in the complaint. Most people are happy to have someone help them with their problem. 3. conduct an impartial investigation. Don't run the ham down to butter up your host, nor run the complainant down to make the ham feel better. For one thing, remember that after your investigation has been completed, you must go back to all parties concerned and review your findings. This job is easy if you were successful in eliminating the trouble, but requires tactful straightforwardness if not. Conduct an efficient and businesslike investigation. The use of walkie-talkies and the committeeman back at the ham station relaying your instructions to the operator help greatly in this and impress your host.



Determine how the interference is getting into the TV set. Disconnect the lead in and move it away and if this is the source, try a Drake type TV-300-HP high pass filter placed and connected electrically as close to the set input as possible (only a few inches) and be sure to connect its case to the TV chassis with a short heavy braid. Check the power line source by inserting a Cornell-Dubilier type IF-18 low pass filter into the line with the same precautions described for the Drake filter. Remember, you are under no obligation to leave either or both units if they eliminate or reduce satisfactorily the interference. They are part of your test equipment group. You may agree to purchase (be sure you know the price!) and install them if paid in advance, or circumstances may dictate staying clear of any involvement in this area. Compare interference results with at least three neighbors in addition to the complainant. Continue to compile results in your report. Even though your investigation shows no interference whatsoever except at the location of the complainant, plan to make electrical tests of the interfering transmitter-antenna system. Experience has shown that some TV sets are bothered by a small malfunction, and even though they may actually be at fault, remember your primary job

is to eliminate interference in any way you can.

So, back to the transmitter. If its power line current does not exceed 5 amperes use the C.D. type IF-18 filter to check R.F. leakage through this path. For greater currents you will want to make up a 15 ampere unit in a shielded box as part of your committee equipment. It should be of the balanced type with two 0.1 mf 600 volt feed-through type capacitors from each side of the AC line to the case, two series inductors, and two similar connected capacitors to the case again. Each group should be in its own shielded compartment. Use No. 12 enamel wire, wound for a length of about six inches on an approximately one inch diameter non-metallic form for each coil. Install either filter in the transmitter power line as previously described for the TV set. Check the transmitter earth ground system. It should have one and it should be an effective one, with large diameter bus or braid running to several copper stakes (or tubing) driven deep enough to insure contact with permanently moist earth. Watch out for ground systems that have a length that is harmonically related to the operating frequency. The result can be a high value of R.F. on the ground line and subsequent trouble. Try changing its length. To check interference through the antenna system, load the transmitter into a proper size light bulb. Three sizes will take care of this requirement, 25, 150, 500 watts. If the trouble disappears, use the inductance in the station matchbox to check for harmonic radiation with your grid dip meter (non-oscillating condition) which should be capable of operating up to at least 200 Mcs. If a matchbox is not used, install yours (another piece of test equipment) to make the check, and also test for TVI at this time. Possibly only your unit is all that is needed to clear up the trouble. Look for loose coax connectors and poor grounding of the coax braid to the connectors. Check the VSWR of the antenna system with your wide range R.F. oscillator (more test equipment). If it is above 2.5 or 3 to 1, look for trouble here. Correcting it may eliminate the problem. A length of your own same type coax, preferably a quarter wavelength, when inserted in the regular feedline may show that an original low VSWR is now high, indicating system trouble (mismatch) and that initially you just happened to have the SWR bridge connected in at an impedance close to the line value. For transmitters operating below six meters, try your low pass R.F. filter (more test equipment), which matches the coax impedance and has sufficient power capability such as B. & W. types 425 and 426 (50 and 75 ohms respectively). It should be the last component in the feedline (that is, nearest the antenna). Where applicable, check a phone transmitter for modulation percentage and proper waveform appearance. Use your receiver with the last I.F. stage coupled through approximately 25 pf to your wide band oscilloscope.



For the first investigation summary, let's assume that you were successful in locating the trouble and solving it to the satisfaction of everyone. Your review is easy in this case. Complete your report and file it. Each case makes future investigations easier to solve.

For the second summary, let's assume you were again successful in locating the trouble but that its solution requires changes or additions (including the purchase of something such as filter) to the TV set because it is the only one in the neighborhood subject to interference The problem you now face is in direct proportion to the opposition of the complainant to buy something for a set, which to him is receiving TV signals satisfactorily In your explanation you must first put yourself into his non-technical position, then simultaneously point out the results of the investigation which shows that because no other local set shows signs of interference, the ham transmissions are clean and his set alone has an inability to discriminate against the strong local (ham) signal operating on a frequency far removed from the TV channels.

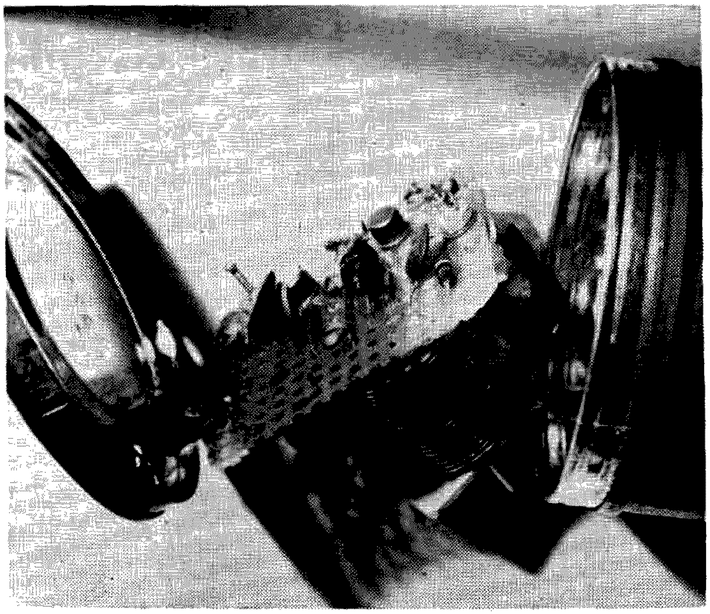
For the third summary, your investigation shows one or more things actually wrong, or in poor practice at the ham station. Usually this results in interference to a number of neighbors. Nearly always, the operator will be only too glad to cooperate and make any changes you recommend to get out of trouble. If you ever do encounter resistance to recommendations, you can only point out that you can no longer support him against the neighborhood, and while you won't "tattle" his non-cooperative attitude, you must report that your hands are tied in solving the problem at that

location. You can point out to the ham that at least one neighbor will probably complain to the FCC. Since most club TVI committees are known to the local office, you will receive a complaint review form to complete, and if your report shows non-cooperation, that ham will have two strikes against him initially if the FCC steps into the case.

For the fourth summary, your investigation shows nothing wrong at the ham station, but he is getting into one TV set badly which is connected into a community cable system, with other sets either having only slight interference or none at all. Obviously the trouble here is that sufficient R.F. signal is leaking into the system to show up on a malfunctioning TV set. Explain the situation to the company who, because they are concerned about protecting their system reputation, will probably be very quick to put a test TV set into the home of the complainant just long enough to show that his set alone is subject to interference. If you find several TV sets that are being interfered with (again, proper ham station operation), the community system probably is not operating correctly (examples, mismatched lines or/and loads, poor grounds, malfunctioning amplifier-distribution boxes, etc) and a report should be given to the company for their investigation, and to the local FCC office for their files if the situation warrants it.

An example of reverse interference (to the amateur) is wide band noise (buzz, hum, crackle, etc) heard in the communications receiver as a result of a faulty power system. The cause may be a bad transformer, intermittant line connection, power leakage, etc. Noise can travel great distances from its source which makes its detection very difficult, since you must work on the ground. However, by using a portable receiver or your car set to cover a wide area to determine generally the extent and probable source of noise, and then using the portable set on foot, you probably will find the source location. The more complete your investigation is, the more effective you will be in your contact with the power company. Do not waste your time by going to the front office and filling out some form which starts with an office girl. Go to the Service Department and review your case with the supervisor, making sure you leave a copy of your investigation for his use.

So, enlist and serve as your area TVI committee. Once you learn the ropes by solving a few interference cases, you really will enjoy contributing to the benefit of hams and public alike. . . . WA6OQP



Harley Gabrielson W6HEK
Robert Tellefsen W7SMC/6
277B Tyrella
Mountain View, Calif.

A Coffee-Can VXO for Oscar III

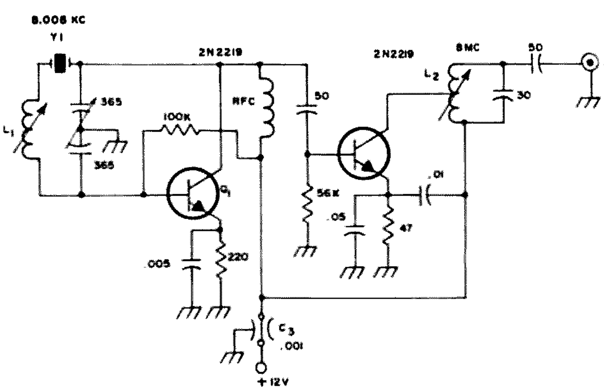
When OSCAR III goes into orbit, a great many hams will be trying to communicate within the 50-kc passband of the satellite translator. Some form of VFO will be just as necessary for operation here as on 20 meters.

With this need in mind, an 8 mc VXO (variable-frequency crystal oscillator) was constructed for use with a Heath VHF-1 Seneca 6 and 2-meter transmitter. It produces ample drive to the transmitter, it is extremely stable, and the 50-kc band occupies about 90 per cent of the 100-division dial used.

The schematic diagram is pretty much self-explanatory, but a few things should be pointed out. The transistors used here were 2N2219's, but any good 30 mc or better transistor can be used. Variable capacitor C1 need not have sections of equal value, nor need the values be as much as the 365 mmfd used here. A plain broadcast variable with unequal sections was used in this unit, with the smaller capacity section connected to the collector of Q1.

The input frequency range of the translator is 144.075 mc to 144.125 mc, so the crystal frequency must be one-eighteenth of this. The VXO circuit pulls the oscillator frequency lower, so when allowance is made for the effect of circuit capacitance, an 8.008-mc crystal is just about perfect. At this frequency it is not difficult to pull the crystal oscillator the needed 4 or 5 kilocycles.

Coil L1, in series with the crystal, determines how far the dual capacitor C1 will pull the oscillator frequency. It must have a high Q and be self resonant higher than the crystal frequency. As the inductance of L1 is increased beyond a certain amount, the crystal will lose control and the oscillator will become an inferior VFO. The best results are obtained when L1 is adjusted so that C1 pulls the oscillator frequency over just the range desired and no more.



Oscar III VXO

Coil Data

L1 20-25 μh
L2 Resonate at 8 mc. Tap 1/3 up.
RFC Small 50 ma rfc.

The buffer-amplifier stage, Q2, is coupled to the collector of Q1 through a 50-mmfd capacitor. The smallest capacitance consistent with adequate output should be used. Transistor Q2 derives its operating bias by rectifying rf drive from Q1. When the collector circuit of Q2 is resonated, approximately 10 volts of rf should be obtained.

The VXO was constructed on a scrap of

perforated Fiberglas board, which was then mounted on the rear of variable-capacitor C1. A hole was drilled in the bottom of a half-pound coffee can for the shaft of C1. Three other holes were drilled to permit mounting C1 directly to the bottom of the can. When the can is laid on its side, the bottom becomes the front panel of the VXO. The rf output connector and the feed-through capacitor for the dc input are mounted on the can lid and connected to the circuit by short flexible leads. An additional hole was drilled in the lid to permit adjustment of L1 while the lid is in place.

Before adjusting the VXO, connect its output through a short piece of coax to the input of the transmitter. This is necessary because of the effect of the coax capacity on the output coil L2. Calibrate the VXO by fully meshing the plates of C1 and adjusting L1 to produce a two-meter output at 144.075 mc. When C1 is unmeshed, the frequency should be about 144.130 mc. Set C1 to the middle of its range, and peak output coil L2 for maximum drive to the transmitter.

On-the-air checks with this VXO show its stability to be equal to a regular crystal oscillator.

. . . W6HEK, W7SMC/6

Transistor, Hi, Hi

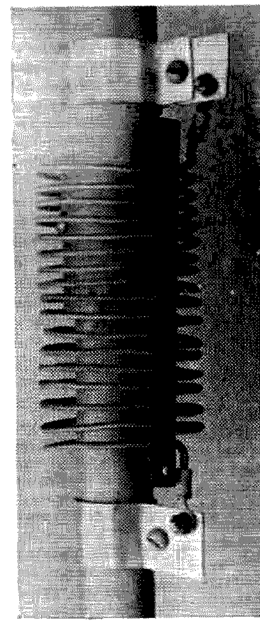
A 100 yen cab ride from the Tokyo station gets you to a radio row that will stand up against anything in Chicago or New York: Akihabara. There are rows and rows of open air stalls, each stall a "store", and each merchant a specialist. One sells electrolytics, another disc ceramics, another ½ watt resistors—and so on down through all the parts. There's even a knob man! Mechanical filters sell for Y 4,950 (360 yen equal one dollar). Transistor transformers go for Y 140. There is a small semantic problem, however. I don't speak Japanese and most of them don't speak English. Hi means "yes" not "hello" there. Finding out where the nearest jon is turns into a major exercise in sign language. To communicate your desire for a transistor good for a couple of watts at two meters requires more than sign language. To that end data on Japanese transistors useful at VHF was gathered.

The data should be of some use to the amateur population. Japanese transistors are of good quality and, because of their price, are appearing in more and more equipment. No voltage polarities are given because this is defined in each transistor's numerical identity. The "A" in 2SA213 stands for PNP. The "C" in 2SC38 tells us it is an NPN transistor. The parameters given can be assumed to be max at the specified temperature and without heat sink. The current price is included in the last column not because either Wayne or I have a financial interest in the Japanese transistor market but because the amateur usually buys transistors by a simple equation: most power input at highest alpha cut-off at lowest price . . . And, it's helpful to know ahead of time how far down in the pocket you'll have to dig to replace one.

. . . K6QKL

No.	V_{cb}	I_c (ma)	V_{eb}	P_c (mw)	T_j °C	F_{ab} (mc)	PRICE (YEN)
2SA24	30	10	0.5	60	70	100	-
2SA25	25	15	0.5	50	70	100	-
2SA57	18	5	0.5	55	75	85	270
2SA58	18	5	0.5	55	75	75	260
2SA61	20	10	0.5	100	75	70	-
2SA68	20	10	0.5	100	75	70	-
2SA69	20	10	0.5	83	75	70	500
2SA70	20	10	0.5	100	75	70	600
2SA71	20	5	0.5	100	75	100	700
2SA76	18	5	0.5	55	75	130	570
2SA77	18	5	0.5	55	75	110	540
2SA87	30	10	0.5	80	85	100	-
2SA90	30	20	0.5	200	85	100	-
2SA116	30	10	0.5	80	85	120	-
2SA117	30	10	0.5	80	85	110	-
2SA118	30	10	0.5	80	85	100	-
2SA123	15	2	0.05	15	65	100	900
2SA134	20	10	0.5	80	85	140	-
2SA135	20	10	0.5	80	85	150	-
2SA213	15	2	0.5	15	65	140	-
2SA234	20	10	0.5	80	85	110	-
2SA235	20	10	0.5	80	85	125	500
2SA238	25	30	1	200	85	700	3900
2SA241	20	5	0.4	50	75	200	1200
2SA242	20	5	0.4	50	75	250	1500
2SA243	20	5	0.4	50	75	300	1700
2SA244	25	30	0.5	200	85	600	1300
2SA245	25	30	0.8	200	85	700	1400
2SA246	30	30	0.5	100	85	175	500
2SA247	10	30	1.2	100	85	200	-
2SA253	20	30	1.2	200	85	450	-
2SA288	20	10	0.5	80	85	500	1400
2SA289	20	10	0.5	80	85	600	3900
2SA290	20	10	0.5	80	85	700	4680
2SA308	20	5	0.3	50	75	450	4000
2SA309	20	5	0.3	50	75	600	5800
2SA310	32	25	0.3	100	75	450	7000
2SA316	18	20	0.5	60	75	75	350
2SC15	30	50	5	750	175	180	2400
2SC25	60	60	3	500	150	70	900
2SC26	60	100	5	500	150	250	-
2SC28	40	50	5	225	150	100	-
2SC29	40	25	5	115	150	100	-
2SC31	60	80	5	1.5W	150	230	860
2SC32	60	80	5	1.5W	150	280	1150
2SC33	45	50	3	150	150	270	4600
2SC38	40	80	8	500	150	200	540
2SC49	120	300	10	800	175	160	8600
2SC150	20	100	1	750	175	100	2570
2SC151	40	100	4	750	175	130	2900
2SC152	60	100	4	750	175	160	5100
2SC160	20	20	1	125	150	100	2420

Multiband Vertical Antenna



Closeup of trap construction, in particular the mounting of the inductor.

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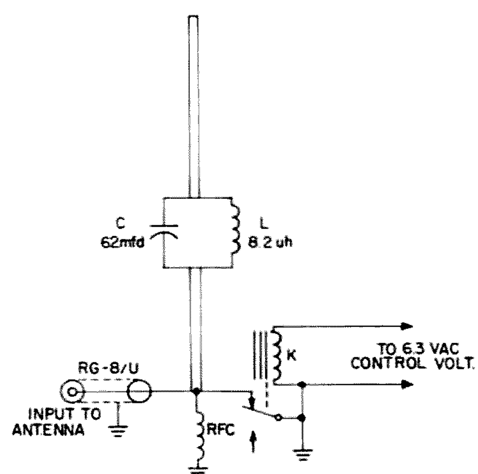
Cockeysville, Maryland

Many hams would like to install a vertical antenna but are stumped for a suitable design that will work for all bands and be structurally strong. Hre is one such design that I have found very successful on both counts.



Schematic of Multiband Vertical Antenna.

C = See Trap Details on Figure 3.

L = 17 turns of #10 gauge enameled wire spaced 4 turns to the inch or Illumitronics #2404T coil stock.

RFC = 110 turns of #22 gauge enameled wire closewound on a 1 inch dia. piece of solid polystyrene rod. (Make a 4 inch piece of rod and fill 3 inches of it).

K = Potter-Brumfield type PR5AY with a 6 volt AC coil—SPDT contacts.

The all band problem can be solved a number of ways, but after trying several, I decided to use a trap design. Two diameters of the antenna tubing were used for the plates of the capacitor and the inductance is supported surrounding the tubing as shown in the photograph of the trap. The trap was designed by covering cardboard tubing of the size of the aluminum tubing with aluminum foil wrap. Thus the trap was designed in the comfort of my basement long before the procurement of aluminum tubing. If you are designing a tubing capacitor where the lengths are long, you may wish to try this idea. It will also save you from chopping off a short length of your precious tubing just to experiment with.

The schematic of the antenna is shown in Fig. 1. The trap is resonant at 7.1 mc. Because the impedance of a parallel tuned circuit is infinite at resonance, the trap serves to disconnect the portion of the antenna above the trap from the portion below the trap at 7.1 mc (40 meters). The mechanical length of the lower section is not a classic ¼ wave length long at 40 meters because the effective diameter of the antenna approaches that of a 5 inch diameter cylinder. The capacitance of such a body with respect to earth greatly reduces the mechanical length required to obtain the desired electrical length.

On 80 meters the trap is inductive and this inductance plus the total length of the antenna serve as a ¼ wave radiator. On 20 meters and above, the trap is capacitive in character and therefore shortens the electrical length of the antenna. The feed impedance varies from 22 ohms to 196 ohms and RG-8/U was selected for the feed line.

The VSWR on 40, 20, 15 and 10 meters is less than 2 to 1 across each of the bands. On 80 meters we run into the perennial problem of bandwidth with small diameter radiators. It is impossible to cover more than about 75 kc and remain below 2 to 1 on VSWR. When we tune the antenna we will set up the radiator length for the desired portion of 80 meters and let the other bands "fall where they may". The VSWR on 80 meters will be about 3.8 to 1 over the entire band and less than 2 to 1 over the 70 to 80 kc bandwidth just mentioned.

Note the rf choke from the base of the antenna to ground. This choke bleeds off electrostatic charges and therefore reduces the possibility of damage to radio equipment connected to the radiator. It is wound on a piece of 1 inch solid polystryrene rod and mounted at the base of the antenna. It is connected to the antenna and ground with copper braid made from the braided shield of RG-58/U coax.

The grounding relay is wired in fail-safe fashion to ground the antenna when it is not in use. This relay is mounted inside a 3 × 4 × 5 inch Mini-Box and mounted at the base of the antenna. Copper braid is used to connect the relay from ground to antenna. The box can be easily waterproofed by sealing all seams with liquid rubber. This liquid rubber is obtainable in any dime or hardware store.

The antenna ground system consists of seven radials of aluminum stranded wire buried about 6 inches beneath the earth's surface. A sod edger shovel can be used to slice a slot in the ground. The aluminum wire should then be laid in the slot and the earth tamped shut. The result will be no scars to your lawn from the installation. Each of the aluminum ground radials should be clamped to an aluminum pipe driven 3 feet into the ground at a distance of 6 inches from the base of the antenna. The use of an aluminum strap prevents problems from dissimilar metals when clamping the radials. No spray coat or preservative was used on this ground radial connection in my installation, but an application of liquid rubber over the entire joint would probably make a more workmanship job.

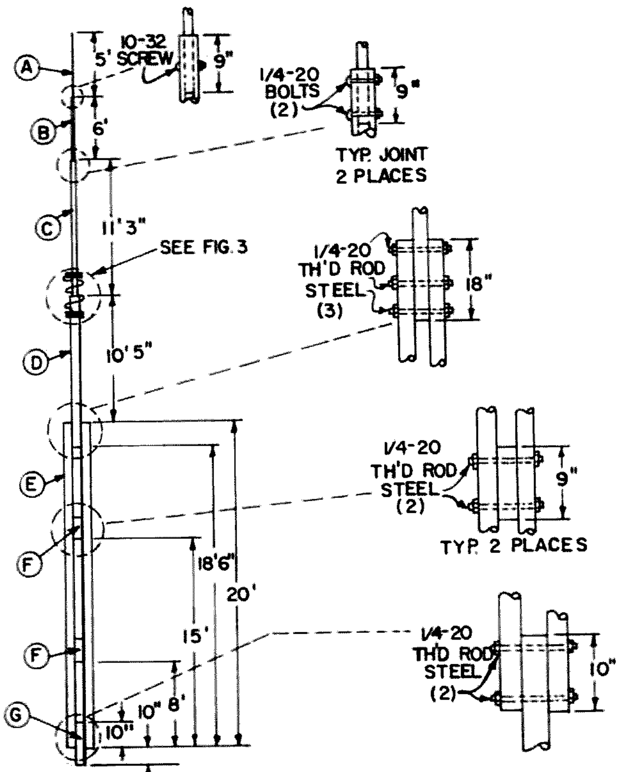


FIG. 2
Construction of antenna.

TUBING LEGEND - See Figure 2

A	1/4 inch O.D.
B	1/2 inch O.D.
C	1-1/2 inch O.D.
D	2 inch O.D.
E	2 inch O.D.
F	2 inch O.D.
G	2 inch O.D.

NOTE: All tubing is 2024S-T4 aluminum with .043 wall thickness.

While in my installation it was not possible to lay radials about the entire 360° of the base because of the house, I have not noticed any bad effects on the radiation pattern. The lengths of my radials are as long as possible, but in no case longer than 40 feet. The purpose of the radials is to establish a good ground system, so if you can install more radials than this and make them longer, by all means do so. A practical limit would be 13 or 14 radials of 70 feet length.

As for the antenna itself, I used some unused sections of aluminum tower for the lower portion. If you don't have some tower sections handy, don't despair. The design shown for the lower section (see Fig. 2) is much stronger than required, is cheaper by far,

much lighter and offers a lot less wind resistance than mine! I used the tower sections for three reasons: (1) I had them. (2) I wanted to use them for something and (3) my mind was blocked concerning a simpler and more effective lower section design.

If you use the more practical design shown in Fig. 2, you should note the use of spacer tubes between the two main vertical mumbers of the lowest section. These connections are important as they serve to distribute the loads evenly among the two vertical members.

The base of my lower section is mounted on six 1¾ inch high ceramic honeycomb stand-off insulators. Since the load on these insulators is both compression and shear, they are of good quality. The insulators are screw-fastened to a fir wood block which, in turn, is secured to a one cubic foot block of concrete in the earth. For the design shown, an excellent insulator would be a large 1 quart soft drink bottle. To install this bottle insulator, the bottle should be coated generously with petroleum jelly. After digging a 1 foot cubic hole in the ground, place the bottle on a brick in the hole. Pour cement into the hole and around the bottle. When the cement is just about firm, *carefully* rotate the bottle to free it slightly from the concrete. When the cement is hard, you will be able to remove the insulator should it ever need replacing. As a safety feature, you should insert a steel or aluminum rod inside the bottle. The length should be such that it extends up into within ¼ inch of the lip. With this rod in place, the foot of the antenna cannot slip out should the insulator ever break.

The structural details of the trap are shown in Fig. 3. Notice the hole through the center line of the trap insulator. This hole prevents water from lodging in the antenna and also prevents split tubing in climates where the water would freeze. The insulator is phenolic resin reinforced cloth and is obtainable from many plastics supply houses. I would guess that seasoned white oak could also be used if it were first coated with transformer varnish or boiled in wax for 3 or 4 hours. A high school wood shop or a friend can usually be counted on to perform the simple lathe work required if you don't have one . . . (I don't).

After machining the plastic insulator it should be placed inside the smaller diameter tubing. Using a number 41 drill, drill about 10 or 12 holes in the tubing and into the insulator to at least ½ inch depth. Remove the

insulator and tap each of these holes with a 4-40 tap. Drill out each of the holes in the aluminum tubing with a number 32 drill to clear a 4-40 cadmium or nickel plated machine screw. Reinsert the insulator and fasten it to the tubing with one or two ⅜ inch long screws, lightly. With a ¼ inch drill, drill a hole all the way through the diameter of the aluminum tube and insulator in two places as shown in Fig. 3. Remove the insulator and, using a ½ inch drill, enlarge the ¼ inch holes in the aluminum tubing only. Assemble the insulator inside the smaller tubing permanently with 4-40 screws ⅜ inches long. We're just about finished with the trap.

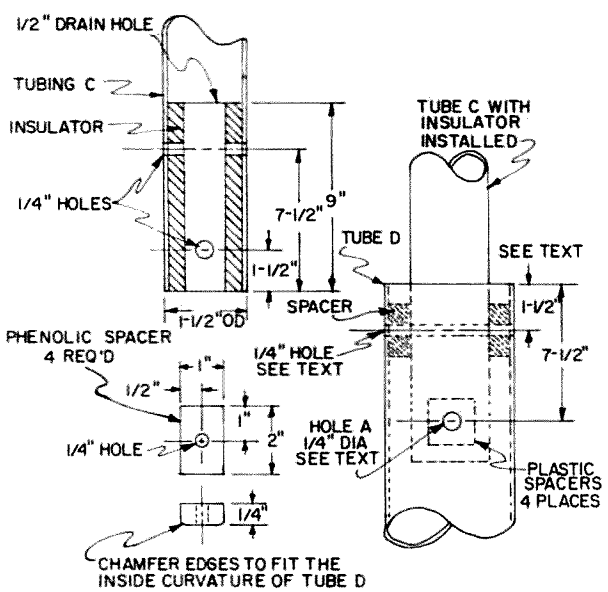


FIG. 3

Referring to Fig. 3 again, locate two ¼ inch holes in the large aluminum tubing as shown. Drill *only* the lower hole marked "A" and drill this one *only* through one wall of the tube. Now place the smaller tube inside the larger tube and when the lower holes of each are lined up across the diameter, drill a ¼ inch hole through the other wall of the large tube using the ¼ hole in the insulator as a guide. Remove the drill and place a ¼ inch machine bolt into this hole. Measure the location of the other through the hole in the insulator from the lip of the large tube. After carefully locating this position on the outside of the large tube, drill a hole through the large tube, through the insulator hole already drilled and through the far wall of the large tube. Remove the ¼ inch machine screw and pull the small tube out. Clean up the burrs on the inside of the large tube.

Make 4 spacers as detailed in Fig. 3. Fasten these to the outside of the small tube with *one layer* of plastic electrical tape. These spacers must be in line with the through holes of the insulator.

Carefully re-insert the small tube inside the larger tube and place ¼ inch cadmium or nickel plated machine bolts through the assembly. We now have a joint which is mechanically strong and electrically forms a capacitance between the large and small tubing.

My coil was wound with #10 wire and supported with aluminum straps around the large and small tubing as shown in the photographs of the trap. The wire was prevented from shorting against its neighboring turns by means of a split insulator made from 2 strips of plastic. The two strips were clamped together and a hole for each turn drilled through the parting line. All this trouble can be avoided by using ready made coil stock. Use Illumitronic Engineering #2404T coil stock material.

The antenna could be guyed from the top of the lower section, but I chose to mount mine on the side of the house. By using 2024S-T4 aluminum tubing of 0.043 wall thickness, the antenna is very light and yet doesn't require any support other than at the base and a bracket to the house about 8 feet up from the base. A "W" shaped mounting bracket was constructed of 2 x 3 inch fir and was painted with redwood stain so that it would blend into the color of the brick of my home.

Tune up of the antenna can best be done by means of an impedance bridge[1] and rf signal generator. Specifically, I used an antenna scope[2] and Heathkit rf signal generator. How anyone who constructs and adjusts antennas can operate without such a device is beyond me. If you don't have one, now is an ideal time to remedy the situation.

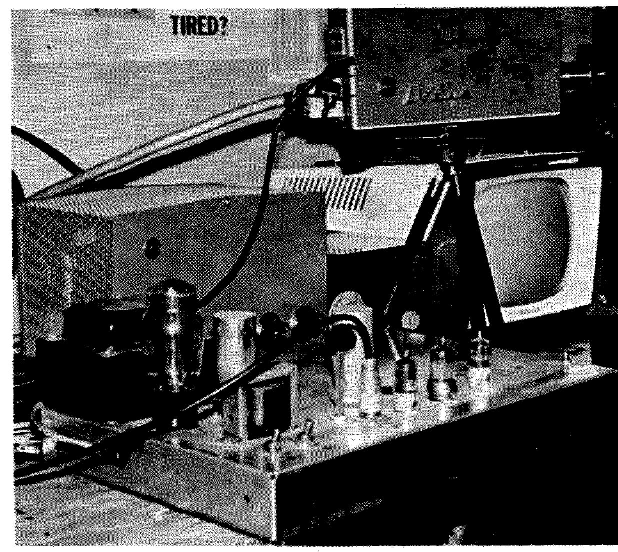
Connect the impedance bridge between the antenna and the ground post. Adjust the output of the generator driving the bridge until the bridge null meter reads about ½ to ¾ full scale. By rotating the frequency dial of the generator appropriately, all the dips of resonance will be found on the bridge null meter. Lengthen or shorten the uppermost length of the tube to obtain resonance at the desired point on 80 meters. Check the other resonant points again. They probably have shifted but you will still find a 2 to 1 or better VSWR across each of the bands. The antenna is fed with RG-8/U at the bottom of the base.

Thus far, the antenna has withstood winds and gusts to 60 mph. Because of the nature of 2024S-T4 aluminum, the antenna literally springs back to shape after such a blow. Good luck and happy DX hunting!

. . . W3UWV

1. Radio Amateur's Handbook.
2. C.Q., June and July 1954.

Practical details in getting on the air.



Let's Go Ham TV

Eugene Mitchell K3DSM
352 Woodley Rd.
Merion Stn., Pa.

Experimenting with ham TV is much more fun and interesting than working with any other phase of communications. It's not really expensive when you compare it to most of the sideband equipment presently on the market. And besides, it makes possible some of the most unique eyeball QSO's that you will ever experience!

The knowledge required to operate a ham TV rig is very little compared to what you would have to know to operate a commercial TV station. If you can tune up and operate an SSB transmitter, you can make the few adjustments necessary to operate television. You can even build a camera without too much technical knowledge.

Basic to all television systems is the electron beam which sweeps back and forth across the pickup tube of the camera and the viewing screen of the television receiver. This is very similar to the way that you read a book. The camera and receiver are both syncronized so that the beam is always at the same place on both the sending and receiving ends. In the camera, the electron beam converts the optical image into an equivalent electrical signal which is used to modulate the electron beam in the picture tube at the distant receiving point . . . thus reproducing the original scene.

One of the cheaper ways of sending a picture is by using slow-scan or FAX. Detailed construction data * was written by WA2BCW some years ago. This type of television generally uses a flying spot scanner of special design and can only be used to scan slides and other still type material. Since the scanning rate is so slow compared to regular television, a special receiver incorporating a CR tube with a slow decay must be used. Otherwise, you would only see a line of the picture at a time. By the time the next line is scanned, the former line would be disappearing. Because of the narrow band width, it can be used with any phone modulator, transmitter, and receiver. The scanner connects to the microphone jack, and the receiving picture circuits connect to the audio output of the receiver.

There is no end to the experimentation that can be done with television. Recently, a complete amateur color television system * using conventional NTSC standards was built and tested with good results.

Cameras

Not having the time to build a camera or flying spot scanner, I took the easy way out and was able to get the RCA TV EYE, a closed circuit television camera, at a very reasonable price. After months of searching, the RCA camera was obtained for $425. Included with the complete package was the lens and vidicon. With careful hunting you can find many similar bargains. The RCA TV EYE has currently been on a closeout sale from RCA ** for $495. cash. This is a complete package, except for lens, and includes a new vidicon with warranty.

Sylvania, Argus, Dage, and many others also have similar cameras on the market with prices ranging from $400-$800 and up. These are all capable of picking up live action, slides, and pictures with excellent quality. Denson Electronics of Rockville, Connecticut handles

* QST, August & Sept. 1958, April 1960, Jan. & Feb. 1961.

* QST Sept. 1960.
** QST Nov. 1962 (page 35).

all sorts of television equipment, new and used. Plans and parts for building a complete vidicon camera are available from Denson. It can be built for about $180 complete. The Electron Corp. of Texas has, up 'til a while ago, manufactured a complete station for ham use. Although this line has been discontinued, you can find some of the equipment at some radio distributors if you hunt around. There are also various army surplus cameras on the market ranging in price from $15-$50. They require slight modification but can provide a very cheap way of getting on live television. Conversion details can be found in the May 1957 isuse of CQ.

Antenna and Receiving Equipment

The antenna and receiving equipment are the simplest parts of the whole station. A simple 13 inch folded dipole can be used for *local* communication with good results. I use a 13 element Hy Gain yagi and a UHF corner reflector (standard UHF TV receiving antenna). Both make excellent transmitting and receiving antennas with gains of about 12-15 db. The yagi costs about $13 and the corner reflector costs about $4. The best feedline is the new foam-filled tubular twin lead which costs about $3 for a hundred foot roll. This has very little signal loss and can withstand the weather very well. Coax and standard twin-lead have losses that discourage their use.

For receiving, a simple UHF converter is used on a standard television receiver. Blonder Tongue has two models available for $18 and $28 which will tune down to 441 mc. These are standard models used for standard UHF reception. The *if* output is normally channel 5 or 6. With this output, the converter will tune down to about 460 mc. By using a channel 2 *if* the converter will receive about 441 mc and up. This has one disadvantage. My model BTU2S, even though it has an rf stage, loses its sensitivity when tuned to the channel 2 *if*. The oscillator and *if* trimmers inside of the converter have not been changed because of the excellent reception on regular UHF broadcast. However, if you plan to use your converter only for ATV it is recommended that you pad the oscillator the required amount leaving the *if* on either channel 5 or 6 as recommended by the manufacturer. A homebrew converter using a nuvistor rf stage is on the drawing board. Hopes are this will bring the gain back to normal for ATV operations and still keep the converter normal for regular UHF broadcast reception.

Transmitters

The transmitting parts of the station can be a very simple, inexpensive, low power sys-

tem such as hetrodyning the rf from the camera to the UHF band, modulating a single tube parallel bar transmitter, or it can be a more expensive unit running crystal control and much more power. The first method, hetrodyning the camera rf, is very well described by W1CUT in September 1962 QST. Further on in this article, a simple way to put video on the air will be described. This uses a single tube oscillator as the transmitter. A tripler-amplifier for 440 mc is described in the ARRL handbook. When used with a two-meter transmitter, it is capable of putting a good stable 20-40 watts on the air.

TV Bands

Worthy of mention at this time is that the ¾ meter band is divided into three sections by mutual agreement between amateurs. The 420-432 mc section is used for FM and unstable oscillators; 432-436 mc is used for xtal control AM and CW, and 436-450 mc is used for television. Violation of this agreement would be frowned on by your fellow amateurs. Since a video signal can extend as far as 4 to 5 mc from each side of the carrier frequency, operation near band edges must be closely watched. The ¾ meter band is the lowest band that ham TV can be used on because of the bandwidth that a video signal takes up. The slow scan system mentioned earlier uses a bandwidth not much wider than a phone signal and, therefore, is permitted on the lower VHF bands where greater range can be obtained. A request was made some time ago to allow slow-scan on 10 and 15 meters, but was denied by the FCC.

Results of Tests

A few tests have been run with W3HPO, K3DOT, and K3ADS, with negative results thus far. W3HPO uses a homebrew vidicon camera and tripler-amplifier, driven by a 2-meter exciter. He runs about 30-40 watts. Although we live only a few miles apart we haven't yet received each other's signals. This is undoubtedly due to low sensitivity of the receiving converter mentioned earlier. Neighborhood tests with the UHF converter have been very satisfactory. One night, a faint test pattern was observed with call letters W3Z??. One possibility was called to my attention, but it is unconfirmed.

TV Eye Camera Modifications

Two very simple modifications were made to the camera unit. (Fig. 1.) An 8 mf electrolytic capacitor was connected to the plate of the 6U8 modulator (IV3-A). This comes out of the camera via a length of RG-59/U coax. This provides video output without rf. The camera has an oscillator with output on any channel from 2-6 for monitoring purposes with a standard TV set. The video output connects to a modulator shown in Fig. 2. It is possible to feed a monitor with the rf from the camera and, at the same time, run video to the modulator of the 441 mc transmitter. Also, a single pole single throw toggle switch

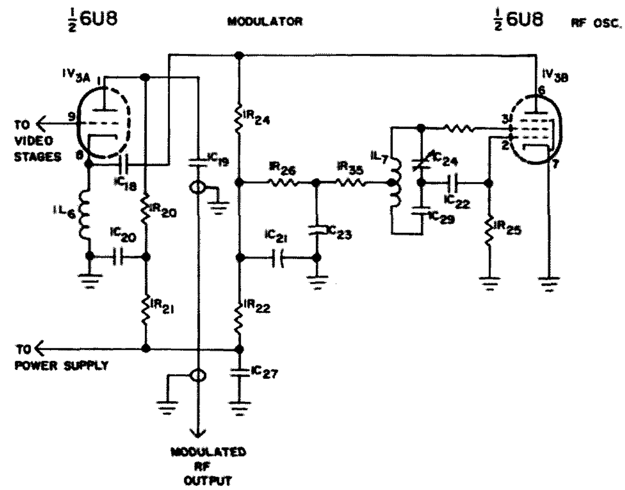


Fig. 1. Portion of RCA camera showing modulator and rf oscillator. Parts are labeled as on the schematic supplied. This is to help in locating the changes.
C1: 8-20mfd 150v electrolytic
To disable oscillator, lift IR24 and IR26 off terminal strip.

was connected to the ocillator B plus lead in the camera to cut it off when not in use. This is not necessary, but nice to have. The switch was not mounted, nor was the cable supplying video connected to a jack. The wires for both come out through an opening in the back right side where they are connected. It was done this way so they could be removed if later it was decided they were not needed.

Modulator-Xmtr

Many get as far as running closed circuit in the shack, but never get the signal on the air. A very inexpensive video modulator and parallel bar transmitter to put the signal from the camera or flying spot scanner on the air will be described at this time (See Fig. 2.). The rf section is a popular circuit commonly found in UHF transmitters of this type. A similar one is found in the ARRL handbook. The modulator has been designed so it can be used with almost any camera or flying spot scanner having video output. Parts layout is not critical in the video amplifier and modulator. The rf section requires the proper spacing of the plate lines and butterfly capacitor. A large chassis was used so room for expansion would be available. The actual size is left up to the builder.

Video circuits are very similar to the familiar audio circuits. When working with video circuits, consideration of bandwidth is very important. It is very easy to chop off high frequencies necessary to the video signal. The video modulator uses no transformers since they cut off these high frequencies. Modulation is usually applied by one of two methods: capacitor coupling to the grid, cathode, or plate, or connecting the modulator tube in series with the plate or cathode of the final amplifier or transmitting tube. Polarity, the changing of black to white and white to black, of a video signal, can be changed by taking the video off either the plate or cathode of a video stage. It can be changed by adding a single or odd number of video stages. When video amplification is necessary you must add two (or any even number of stages) if you expect to keep the same polarity. This is important since the American system requires that we transmit a "negative" video signal; that is to say, the black areas in the televised picture represent an increase of power while the white represent a decrease of power. Frequency multiplication of rf containing video cannot be done without destroying the picture. This modulator can be used on other transmitters, and, if necessary, additional stages can be added when higher power is used. The video amplifiers and modulators are basically the same as audio amplifiers and modulators. The gain control is adjusted until a good clear picture is visible indicating proper modulation level.

Care must be taken to make sure that you stay within the band. Frequency can be checked with the UHF converter connected to the television set and by using leacher wires coupled to the tank circuit. Use of leacher wires is covered in the ARRL handbook. The transmitter was worked the first time into a dummy load. After frequency was checked, the yagi and corner reflector were tried and frequency rechecked. Changing anything in the antenna circuit changes frequency slightly. Frequency adjustments can be made by turning the butterfly capacitor in the plate lines. Frequency is mainly controlled by the length of the two parallel wires which are ¼ wave-length. Very little drift can be detected in the transmitter.

Switching from transmit to receive requires cutting off the transmitter and changing the antennas if you use one for both transmitting and receiving. Using two antennas is recommended since the corner reflectors are available at reasonable cost, eliminating losses in antenna switching. Either relays or switches can be used for changing from transmit to receive. The receiving converter may be left on for monitoring purposes if the camera rf is not used. Fortunately, we do not experience video feedback.

Power Supply

Since the camera has its own power supply, only power to the video amplifiers, modulator, and transmitter are necessary. The supply shown in the picture uses a full wave rectifier and supplies 250-300 volts at about 150 ma

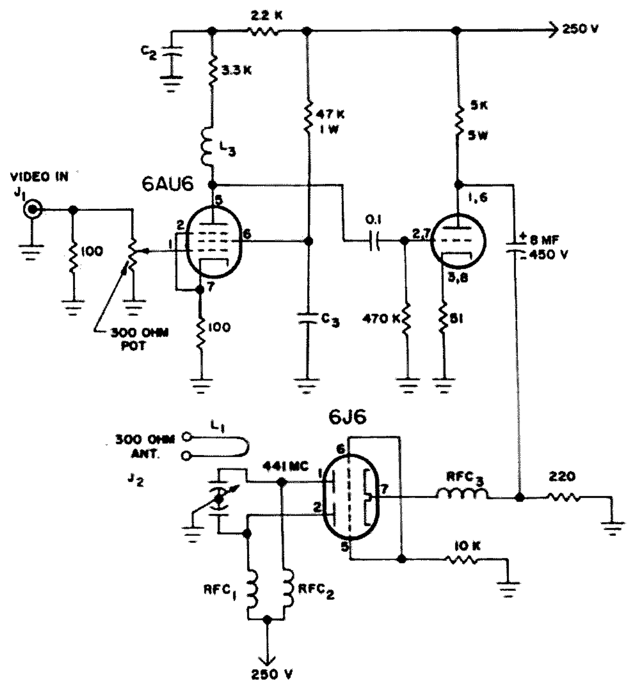


FIG. 2

Fig. 2. Modulator-Transmitter schematic.
Unmarked triode modulator is a 12AT7.
C1 5 mmfd butterfly (Johnson #160-203)
C2, C3 20mfd 450v (part of 4 section unit)
L1 3 inches hookup wire
L2 4½ inches #12 spaced ⅜ inch
L3 200 uhy peaking coil
RFC1-5 12 turns #22 enam. wire on 50K or larger-½ watt Chassis used is 11 x 17 x 4 inches

and 6.3 volts for the filaments. A switch is provided for opening the high voltage center tap to cut off the high voltage during standby. The two capacitors on each side of the filter choke are part of a 4 section capacitor. The other two sections are used in the video amplifiers.

Audio To Go With Picture

There are several methods to send your voice along with your picture: 1) Use of present lower frequency equipment; 2) Separate FM transmitter operating exactly 4.5 mc above the video carrier frequency. This is the standard separation of video and audio and both can be received on the television receiver; 3) A 4.5 mc sub-carrier fed to the

video modulator which will add the audio to the video signal on the same carrier.

When transmitting audio and video at the same time, you must log the transmissions accordingly.

In Conclusion

I have written this article with the hope of interesting more hams to join in on some real fun. After building a TV rig, or even buying one, you want to learn what is going on inside of the equipment. Video theory is not really so complicated.

If you are interested in amateur TV, or if you are already on TV, make yourselves known so we can help each other and swap notes.* There are quite a few on TV looking for schedules. More theory on this subject can be found in the Amateur TV Anthology, published by 73 Magazine.

Being a student in school I haven't had the time I would like to have to experiment with TV. Come vacation though, K3DSM will be buzzing with experiments. Keep a sharp eye out for our CQ-TV!

. . . K3DSM

* One good way to do this and at the same time keep up to date on the latest developments in ATV is to subscribe to ATV EXPERIMENTER. $2.00 per year from 73.

That Professional Touch

Many constructors do not put a top grade finish on their home-brew gear. Most hardwares now carry 'hammer-tone' paint in spray cans, in silver, charcoal black, blue, green and copper. All of these carefully applied from the aerosol cans do a fine professional job of panel finishing.

Black crackle and other black finishes are easy to refinish with Rust-oleum No. 634 Fast Drying Black. Sprayed lightly on dingy black crackle, after washing it with Spic and Span, it results in a display room finish. Trick is to spray very lightly, not enough to mask the texture.

To make the spray paints stick to almost any finish, wash with paint thinner or a good detergent, and dry before painting. Keep it free of finger marks, and allow it to dry a fair period, and a top quality professional finish is available in any shack. (A big help is resisting the impulse to put it all on in one coat, several thin coats work much better.)

. . . Jack Bayha W8BPY

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Solid State SSB Power Supply

At the risk of over-generalization, it can be said that all ham power supplies can be broken down into three types: 1, low power receiver supplies; 2, medium power transmitter supplies; and 3, high power transmitter

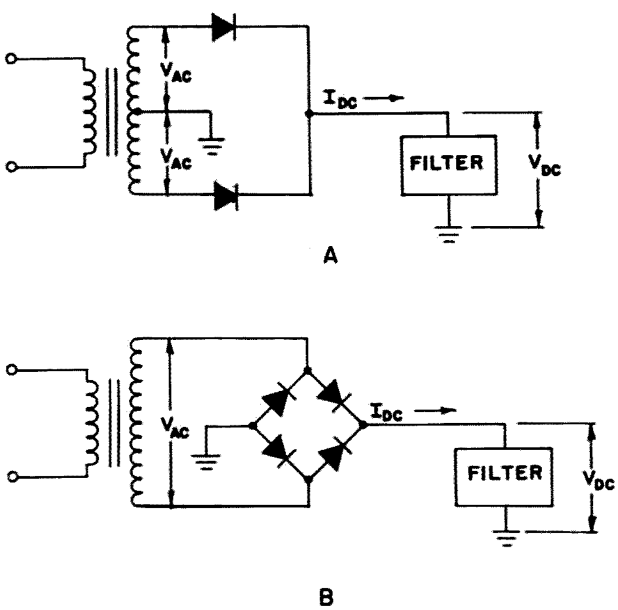

FIG. 1

Fig. 1
a. Full wave rectifier
b. Full wave bridge rectifier

supplies. The recognized trend today is to "semiconductorize" all three types, sending countless 5Y3's, 5R4's, and 866's to the junkbox. Two further trends of modern amateur radio are A, single sideband, and B, transceiver operation. It follows, therefore, that up-to-date amateurs are combining 1, 2, A, and B, and constructing solid state power supplies for their transceivers. Many transceiver manufacturers, of course, are doing the same. While many hams would hesitate to attempt the construction of a SSB transceiver, $50 or $100 or more can be saved by building at least the power supply, a comparatively simple job.

A typical ham's junkbox, (if there is such a thing) may likely contain close to all the components required, keeping the cash outlay to an absolute minimum. Every necessary component is also available on the surplus market at large savings.

The power supply described here was built for the Health HW-12, 22, and 32 single band 200 watt PEP transceivers. The requirements, however, are representative of many on the market. It delivers about 800 vdc at 250 ma peak, 250 vdc at 100 ma −124 vdc for grid bias, and 12.6 vac filament voltage. The bias features zener regulation, and the entire supply has proven very satisfactory in service.

Questions and Answers

Q. My existing power transformer, in a full wave rectifier supply, will only give about half the dc voltage needed for transceiver final. Must I get a new one?

A. Silicon rectifiers lend themselves beauti-

Table 1

	Choke Input Filter		Capacitor Input Filter	
	Full Wave Rect.	Full Wave Bridge	Full Wave Rect.	Full Wave Bridge
PIV	2.8 x vac	1.4 x vac	2.8 x vac	1.4 x vac
Rectifier Current rating	.5 x idc	.5 x idc	.5 x idc	.5 x idc
vac	1.13 x vdc	1.13 x vdc	.85 x vdc	.85 x vdc

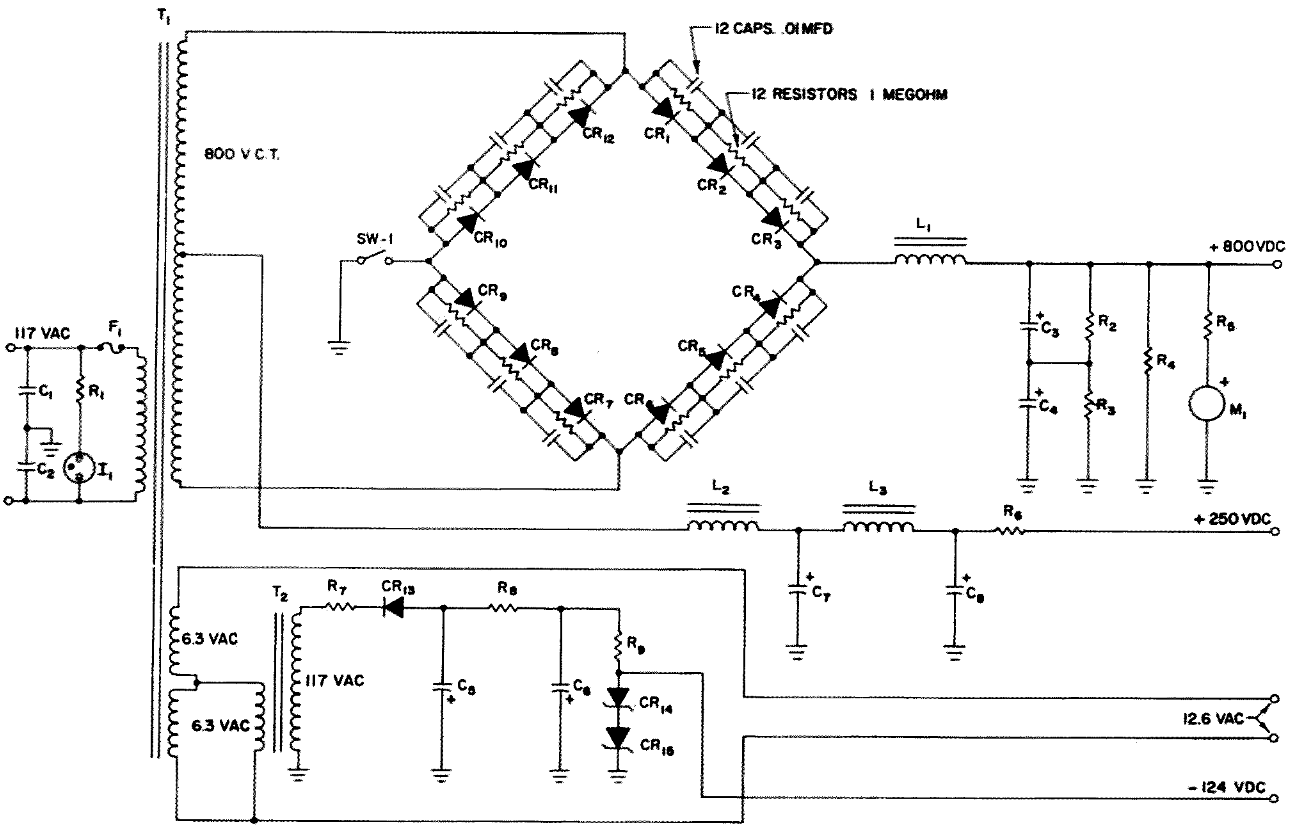

FIG. 2

Fig. 2 Transceiver power supply

Parts List

C1, C2—.001 mfd, 1000 vdc ceramic disc
C3, C4—30 mfd, 500 vdc tubular electrolytic
C5-C8—20 mfd, 450 vdc tubular electrolytic
CR1-CR13—1N547. 600 PIV 750 ma silicon rectifier
CR14, CR15—1N3039. 62 v, 1 w zener diode
F1—4 amp fuse
I1—NE-51 neon indicator lamp
L1—8 h, 250 ma filter choke
L2—8.5 h, 125 ma filter choke
L3—Same as L2
M1—0-1 kv voltmeter, 1 ma movement
R1—270k ½ watt
R2, R3—150k, 2 watt
R4—50k, 25 watt wirewound
R5—1 meg, ±1%, 1 watt
R6—750 ohm, 10 watt wirewound
R7—15 ohm, ½ watt
R8—560 ohm, ½ watt
R9—4.7k, ½ watt
SW1—spst toggle or rotary switch
T1—800 vct 300 ma, 6.3 vac 6 amps, 6.3 vac 6 amps
T2—6.3 vac 1 amp

fully to full wave bridge supplies, since no filament transformers are needed. This will give the required voltage output.

Q. Using a full wave bridge supply for the high voltage, won't I need another transformer for the low voltage receiver and transmitter stages?

A. No. The transformer secondary center tap provides, when filtered, approximately half the DC H. V. output for the low level stages.

Q. Should the bridge supply use a capacitor-input or choke-input filter?

A. While a capacitor-input filter will give a higher output voltage, the choke-input has much better regulation characteristics, and is recommended.

Q. How can I tell what current ratings and peak-inverse voltage (PIV) ratings my silicon rectifiers should have?

A. See Table 1, for both full wave (2 diode) and full wave bridge (4 diode) rectifiers.

Q. Are surge resistors needed in series with the rectifiers?

A. Only with a capacitor-input filter. In a choke-input filter, the inductor itself presents a sufficiently high impedance to protect the diodes. When using surge resistors, remember that at the instant the supply is turned on, the input capacitor has no charge across it. Until it is charged, an abnormally high current is drawn from the supply through the rectifiers. This current must cause a large voltage drop across the surge resistors, to avoid exceeding the rectifier ratings. On the other hand, making them too large will decrease power supply efficiency. 10 or 20 ohms, 1 watt, in series with each leg, is adequate for this type of supply.

Q. Can silicon rectifiers, like capacitors, be wired in series to increase the voltage ratings?

A. Yes, any number can be used in each leg, until the required PIV is reached. The writer is presently planning a 3 KV linear amplifier supply, using strings of 600V PIV rectifiers.

Q. When silicon rectifiers are wired in series, is it necessary to use capacitors and/or resistors across each diode for voltage equalization?

A. Yes. For optimum protection, both should be used. About 0.01 mfd at 600vdc is correct for the diodes used here, shunted by 1 megohm, 1 watt resistors.

Q. Is a large, high-voltage oil filled capacitor better than several tubular electrolytics in series?

A. No. The electrolytics are much less expensive, take up less room, and are no different electrically for this purpose. Use voltage-equalizing resistors across each capacitor, proportional to the voltage ratings.

Q. Won't a bridge supply giving twice the transformer's rated voltage, only give half the rated current?

A. No. Generally, a transformer can deliver at least twice as much peak current as its rated dc value, especially at the low duty cycles usually associated with voice frequencies.

T1, the power transformer, was acquired several years ago as "new surplus." It is rated at 800 vct @ 300 ma dc. The filament windings are rated at 6 amps. The bias transformer, T2, is simply a 6.3 volt filament transformer wired backwards. If this is not available, a 1:1 120v transformer could be used across the ac line. The high voltage portion is a full wave bridge rectifier, using 12 600v PIV silicon rectifiers. It is filtered by a single "L" filter consisting of LI, C3 and C4. R2 and R3 equalize the voltage across the filter capacitors. R4 is a bleeder resistor, and has three functions: it discharges the filter capacitors for safety, it helps to regulate the output voltage, and it keeps the output voltage, when unloaded, from climbing above the capacitor voltage ratings. Because of the quiescent current of the final amplifier, very little bleeder current is required.

M1 is a 1000v voltmeter. A milliammeter in series with the load would have been more typical, but it was desired to monitor voltage regulation rather than load current. It is optional, and either, or both, can be used.

The low voltage, from the transformer center tap, after being well filtered, supplies the receiver section and the low lever transmitter stages. L2 and L3 are also surplus units, and are actually one tapped inductor. R6 is a dropping resistor to obtain the correct output voltage.

The bias voltage is half-wave rectified by CR 13. R7 is a surge resistor, and protects the rectifier. CR 14 and CR 15 are 62 volt, 1 watt zener diodes, giving constant bias voltage regardless of line variations. Very little output current is drawn from the bias supply.

When wiring the filament windings in series, a voltmeter across the output will read either zero volts or 12.6 volts ac. If zero is read, reverse one of the windings, so that they add rather then cancel.

One side of the primary winding is connected through the transceiver function switch to the line, so that the power supply can be switched on with the transceiver. SW 1 is a high/low power switch. Since the power supply is solid state, there are no filaments to warm up, and the full output voltage is at the terminals immediately upon switching on. This is very hard on the transmitter tubes, since their filaments have not yet heated. With SW 1 open, there will be no voltage at the low voltage output, and only half the normal voltage at the high voltage terminals. Full bias, however, will be supplied. After allowing filaments to heat for a minute or so, the switch can be closed, applying full voltage. This should lengthen tube life appreciably. While a SPST toggle switch has worked fine in the writer's supply with no sign of arcing, it may be desired to use a ceramic wafer switch with a higher voltage rating. Of course, the same thing can be done with a time delay relay.

Much wiring can be eliminated, if desired, by purchasing a packaged bridge rectifier unit. These contain the silicon rectifier bridge, with all the required voltage equalizing resistors and capacitors, in a compact potted package with four terminals. One such unit is the Oz Pak, developed for Westinghouse by Ozzie Jaeger, K3OKX.*

This power supply exhibits many advantages over vacuum tube types. The rectifiers run stone cold, there is much less voltage drop across them, they don't require amperes of filament current, they don't shatter when you drop them, and they certainly take up less room. As for price, at least one large surplus house is selling 600 volt PIV units for 36c each. Enough reasons?

. . . W1VIV

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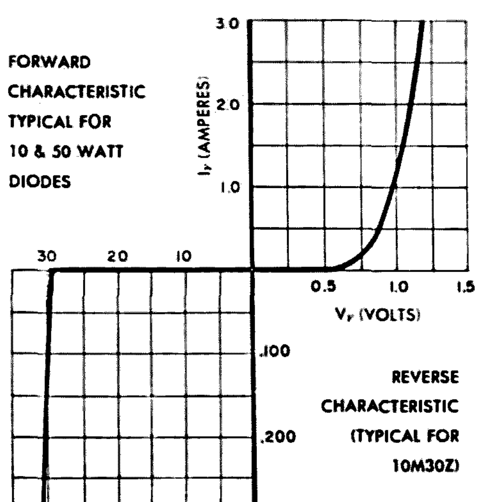
Handy Dandy Zeners

With the advent of transistorized gear, there has developed a need for low voltage regulators. One of the devices used for this purpose is the silicon zener diode. A simplified characteristic curve is shown in Fig. 1. The left hand portion of the curve is the portion we are interested in. Notice that when acting as a zener, the diode is reverse biased, i.e. the positive supply voltage is connected to the cathode. On the curve, current is plotted vertically; voltage is plotted horizontally. Notice that if a voltage in excess of either V_f or V_r is applied across the diode a very large current can flow, thus destroying the diode. For this reason, enough impedance must be connected in series with the diode to limit the current to a safe value.



Suppose we want a regulated 12 volt supply from the unregulated 17 volt output of a rectifier, and the load current varies from zero to 400 milliamperes, (0.4a). Suppose we choose a zener which has its breakdown voltage at 12 volts instead of 30 volts. The voltage across the zener will always be twelve as long as we drop no more than 5 volts across R_s. Now the maximum current the load will draw is 0.4a. The voltage drop across R_s (17-12 = 5) at 0.4a requires: $R_s = \frac{5}{.4} = 12.5$ ohms. However, in order to have the zener regulating the voltage, we must also supply enough current at 12 volts to be well down on the breakdown portion of the curve. From the graph (Fig. 1), supposing it was 12 volts in-

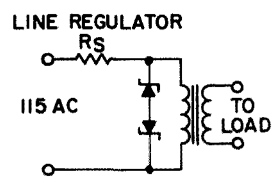


FIG.4

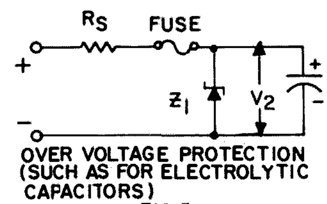


FIG.5

Fig. 4 can be used for lowering and regulating the a.c. voltage to a constant load. This protects delicate equipment from line fluctuations.

Fig. 5. When V_2 exceeds the voltage rating of the zener, it draws a large current, causing the fuse to blow. Z_1 must be able to withstand the current surge.

stead of 30, 100 ma. is well down on the curve. So we will supply the zener with 100 ma. of current. The total current drawn will be 0.4a for the load plus 0.1a for the zener. Thus to drop 5 volts across R_s at a current of 0.5a requires: $R_s = \frac{5}{.5} = 10\Omega$. Isn't that handy? Now at full load the voltage is 12 volts. What happens when we remove the load? We still must draw 0.5a through R_s to stay at 12 volts. Now as the voltage tries to rise, the zener

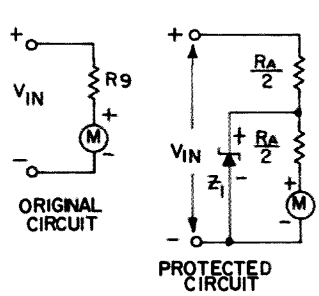


FIG.6

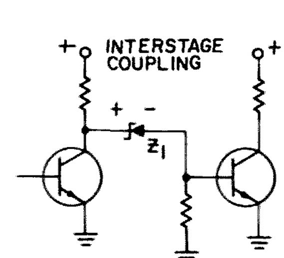


FIG.7

Fig. 6. The voltage across Z_1 cannot exceed the rating of Z_1, thus protecting the meter from excessive current flow, if Vin is too large.

Fig. 7. Since the voltage across Z_1 is constant regardless of the current flow through it, it acts as a very low impedance to an a.c. signal. To a.c. it looks like a large capacitor.

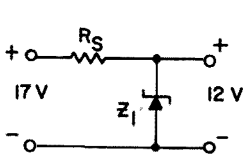


FIG.2

Fig. 2. Basic circuit.

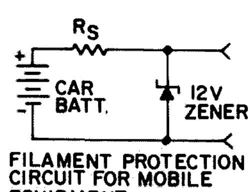


FIG.3

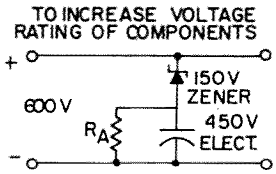


FIG. 8

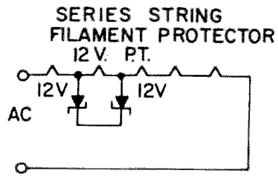


FIG. 9

draws more and more current until the voltage drop across R_s reduces the output to the zener voltage at the current value needed, which is still just about 12 volts. At no load the zener is drawing the full 0.5a needed to hold the voltage at 12 volts. Thus, no matter what the load, within the design limits, the voltage will remain at twelve volts. However, the zener regulates by turning power into *heat*. With twelve volts across it, and 0.5a of current passing through it, the zener is dissipating 6 watts. A ten watt zener can safely dissipate this power if mounted on a *good* heat sink (not just a chassis!!). Notice that the zener can also regulate a varying input. The input can rise to any value, and the zener will still regulate. However care must be taken that the power dissipated does not exceed the ratings. The input voltage can drop

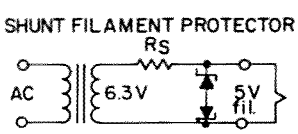


FIG. 10

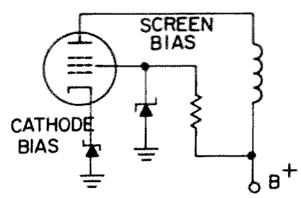


FIG. 11

Fig. 11. Zeners can also be used as biasing elements, eliminating the need for bypass capacitors. In addition, the bias voltage is very well regulated.

until the voltage at the zener terminals drops below 12 volts. In this case: $.4a \times 10\Omega = 4$ volts $12 + 4 = 16$ volts at the input. The number of circuits using zeners is growing constantly. A few of these which might be of interest to hams are shown below.

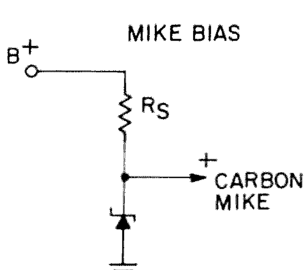


FIG. 12

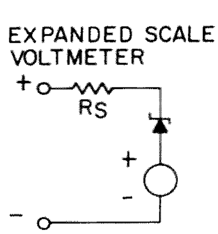


FIG. 13

Just think of the zener as a simple battery that you have to put some current into instead of taking it out, and you will probably think of hundreds of additional uses.

. . . K9ALD

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Cooling Notes on the 4-1000A

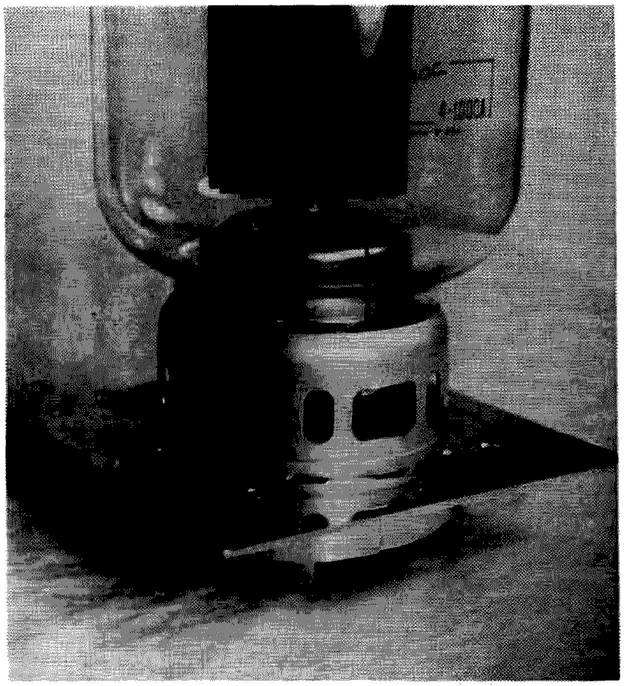

Fig. 4.

Numerous articles have been published concerning the very effective use of the Eimac 4-1000A as an rf linear amplifier, particularly for grounded grid, zero bias class B operation. The purpose of this article is to provide some practical approaches toward the minimization of heat, wasted power, and consequent reduction in the blower noise and requirements for this exceptional tube.

The first consideration was placed upon the filament voltage during standby. In consultation with the Power Grid Division of Eimac, they advised that any reduction in standby voltage will favorably affect the tube life so long as plate current is not being drawn under these conditions. Following this approach, a design change was incorporated using an SPDT relay actuated by the primary voltage of the high voltage power transformer to switch from the normal to a reduced, standby filament voltage in the order of ¾ or less. (Fig. 1) The blower motor may be switched along with the filament primary since the base seal temperature of the tube will now be correspondingly reduced. The results? Less noise, heat, power consumption, and filament thermal shock associated with instant heating at full voltage.

Secondly, it is desirable to eliminate plate current when the plate supply is on and the VOX is open. A very simple 33k five watt wire wound resistor is placed in the filament center tap to ground. In parallel with this resitor is an SPST relay, whose coil is energized through the VOX relay (Fig. 2). This shorts out the self-bias when the VOX relay closes. This system has been in use in the author's amplifier for over three years with excellent results. It also prevents diode noise generation in the amplifier as well. Of course, many other combinations are possible with this relay using additional contacts, such as shorting the receiver input and any other switching frills which one might wish to incorporate.

Thirdly, change an existing Eimac SK 500 socket for their new and improved SK 510. It is a very small investment which will pay off in increased cooling efficiency, thus permitting a further reduction in blower capacity. Unfortunately, the mounting holes do not match in these sockets, but an adaptor plate (Fig. 3) solves this problem or otherwise some re-drilling is necessary on the existing chassis. Because of the plastic body, a low inductance grounding bus was used to return all grounds to a common point at the socket. A word of caution regarding the cooling system. Some operators have lost tubes due to cracked glass in the base caused by failure to adequately cool the tube after all power has been turned off. Here, a time delay relay or other switch-

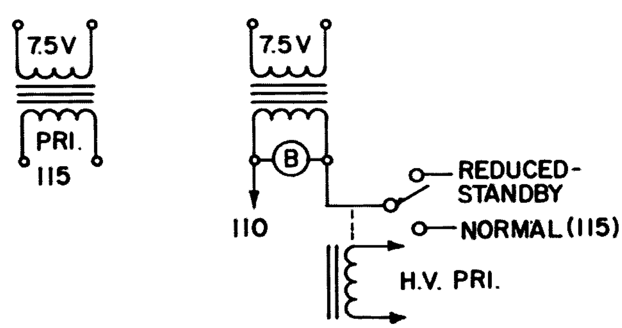

Fig. 1. Before and after filament circuit.

ing will preclude this type of failure by running the blower for 30 seconds to one minute after all plate and filament power have been turned off.

Lastly, as a further means of reducing the back pressure, alternate pairs of holes in the 4-1000A metal base are removed (Fig. 4) with a diagonal cutters. Check the orientation of the holes with respect to the grounding clips for optimum layout. Of course the rough edges should be carefully smoothed with a file after the surgery to eliminate any turbulence. The aluminum or brass is relatively soft and cuts easily. There is still very adequate mechanical strength after this change, and a noticeable improvement in air flow results. However, the limiting consideration of the air flow through the system is the micalex base of the tube which is quite restricted and generates considerable turbulence. The new SK 510 socket assists in this area with 6 points of relief, one at each of the pin connections, and one between pins 1 and 5. This permits some air to flow around the tube base instead of through it and further assists in cooling the plate seal as well as the individual tube pins. A word of caution: use two pairs of pliers if one wishes to bend the lug connectors on the SK 510 as they are brittle at their base. The author broke the first lug in preparation for wiring. Better yet, don't bend the lugs, solder to their base instead.

Regarding forced air requirements, bear in mind that the tube life is related to its operating temperature (C1). Blower noise is usually dependent upon the combination of speed, blade pitch, balance, bearings, motor design, and mounting. In general, these features come only with quality and consequent cost, although the surplus market has been of some help in this area. Eimac specifies that the 4-1000A requires 20 c.f.m. at 0.6 of an inch of pressure for a 1000 watts of continuous plate dissipation up to 30 mcs. with the SK 500 socket. The pressure requirement refers to "the corresponding drop across the socket of 0.6 inch of water column." By most common air requirements for amateur service, this is on the high side with respect to the back pressure, but it was rated with the older, SK 500 socket. Under intermittent duty, such as SSB or CW operation, using the improvements described, one may readily see that the forced air needs were mainly back pressure, and the requirements of the tube are now relatively reasonable for amateur operation. Guesstimating on these bases, it is probable that the blower requirement may now be conservatively rated at 20 c.f.m. at 0.4 inches of pressure.

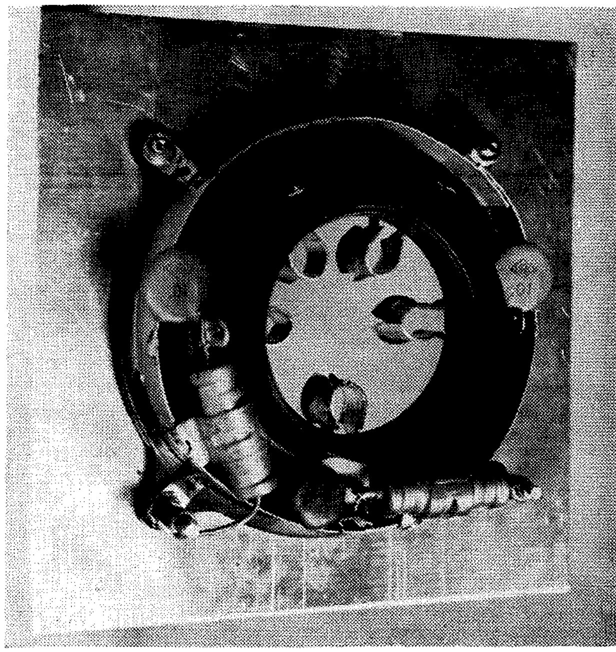

Fig. 3. Mounting plate.

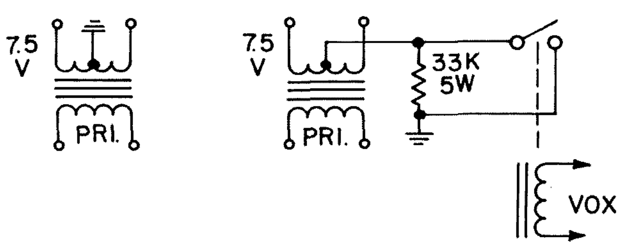

Fig. 2. Before and after cathode circuit.

The use of the methods described will tend to increase the tube life while decreasing the wasted heat in the shack. Further, some of the annoying blower noise may be eliminated as a result of the reduced forced air requirements.

. . . W6VFR

120 Watts Mobile on 2M
Part II

Last month we presented the construction details and schematic for this transmitter. Now here are step by step instructions for tuning and adjusting it.

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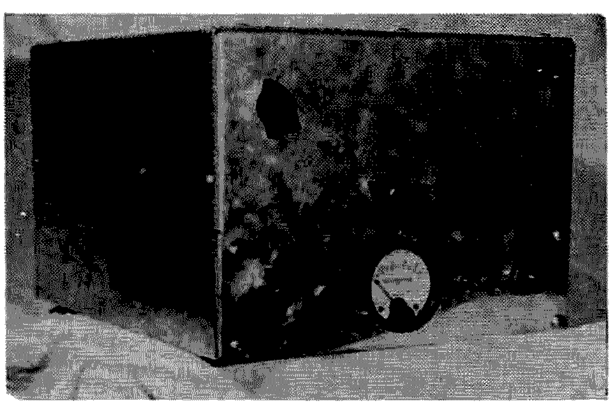
Start by placing "spot-operate" switch on front panel in "spot" position. Connect negative terminal of VTVM to 100K grid-leak of 6EB8 triode stage. Insert crystal between 8 and 8.222 mc in socket. Tune LI and L4 for maximum VTVM indication.

Then remove power and disconnect 100-ohm resistor in second 6360 B+ circuit from 300-volt line. Connect VTVM negative lead, through Z-144 rf choke, to center-tap of L6. Reapply power, switch "spot-operate" to "operate," and key transmitter. Tune CI and C3 for maximum voltage. Adjust C2 to improve VTVM reading. We found the setting of C2, incidentally, to be very critical.

Remove power, reconnect resistor, and disconnect power from both screen and plate of second 6360. Move the VTVM lead (with rf choke) to center-tap of L8. Reapply power, key transmitter, and tune C4 and C5 for maximum. Also touch up C3, in case the circuit was detuned by the presence of the VTVM lead.

Remove power, reconnect voltages to screen and plate of 6360, and switch meter switch to Ig position. Key rig and adjust C6



Front-panel controls of the 120-watt 2-meter rig are crystal switch (12-position) at top left; plate tuning above meter; link (output) tuning just to right of plate tuning; meter switch at lower left; and drive control at lower right. Left-hand toggle switch is spot-operate switch, other toggle is transmit-standby for tuneup purposes. Pilot lamp at left of meter completes the lineup.

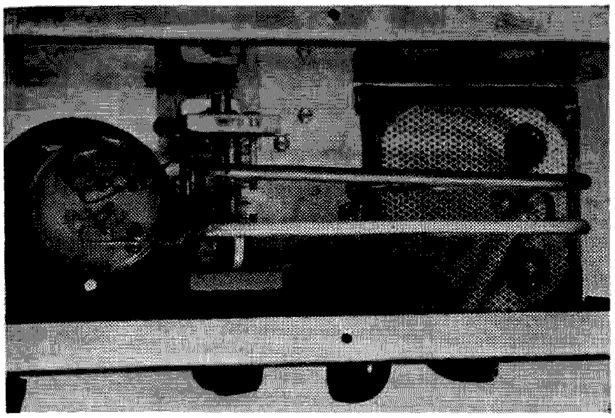
for maximum grid current. At least a mid-scale reading should be obtained, and don't be alarmed if the needle goes completely off-scale. Just reduce the drive with the front-panel drive control and continue tune-up for your peak.

The second 6360 may require neutralization; ours did. It's accomplished by disconnecting one filament lead from the tube socket and connecting 1½-inch lengths of hookup wire to plate pins 6 and 8. Key the rig and connect an rf VTVM at the output terminals (the built-in rf voltmeter gives a starting point but is not really sensitive enough for the final stages of the job). Adjust the length and position of the wires on pins 6 and 8 for minimum indicated output. We ended up with the wires spaced about ⅜ inch from the grid pins. After neutralization, reconnect the filament lead.

Before completing the final-stage tuneup, the exciter stages should be broad-banded. Use three crystals, one at each extreme of the band segments you want to cover and one near the midpoint. We used an 8000 kc, an 8061, and an 8200, since we wanted to cover the entire band but most operation was to be on either 144.010 or 145.098.

Perform initial tuneup with the midpoint crystal. Plug in the band-edge crystal (either one) and adjust C3 and C5 for maximum drive. With the other band-edge crystal, adjust CI and C4. Recheck with the midpoint rock. Grid current in the 5894 should be approximately equal with all three. If midpoint is too low, raise it slightly by tuning CI, C3, C4, or C5 slightly. If it's too high, increase coupling between L5 and L6 by bending the two coils slightly closer together. If you have at least mid-scale grid-current reading, however, you really have little need to worry.

Plate tuning is conventional; dip plate current with the dual-15 mmfd capacitor. Output loading is controlled both by position



Close-up top view of the 5894 final amplifier.

of the link with respect to the lines, and by tuning of the HF-15X loading capacitor. Adjust both for maximum output indication near the middle of the band and they probably will not need to be touched afterward. Operating Ip reading should not exceed 0.66 (200ma).

With rf tune-up complete it's time to hit the audio. For best results an oscilloscope should be used, but passable adjustment can be accomplished without one.

Three controls are involved in audio tune-up. R1 sets the clipping depth, R2 sets the modulation percentage, and R3 sets the modulator resting plate current They should be adjusted in reverse order.

R3 is easy to adjust. Set the rig for fone operation, turn the meter switch to "mod," and key the mike. Don't talk. Adjust R3 for a meter reading of 0.15. This is equal to 50 ma.

R2 should be set to the high-voltage end of its adjustment range to begin with. Set the meter switch to Ip and talk into the mike loudly while keying the rig (use a dummy load of some sort as overmodulation is probable at this step). If the meter needle fluctuates with speech, you're overmodulating. Reduce the setting of R2 until no kick of the meter is observable. Then connect to an antenna and find a very critical friend on the air; have him check your signal for splatter several hundred kc either side of the carrier. If he finds none, you're at least on the safe side of the 100-percent-modulation mark. If you feel lucky or trust his judgment highly, increase the setting of R2 slightly until he reports slight splatter, then cut it back a tad.

Don't worry about any "distortion" he may report. If R1 is wide open and you're talking loudly, the signal will be very deeply clipped and may be almost unintelligible at short range. The only thing you're looking for right now is splatter.

A better method, of course, is to use a scope. Most any kind can be employed by coupling directly to the vertical deflection plates with a pickup loop made of two turns of "zip cord" hung near the final tank lines. With a scope, set for about 95 percent modulation and lock R2 with a drop of glue.

R1 is a semi-operating control; its setting will depend on your mike, your voice, and the amount of clipping you prefer. The lower the setting of R1, the less clipping you will have. It's possible to set it so low that you have no clipping at all, and a setting somewhere near this point will get you the best "broadcast-quality" reports from local contacts.

For long-haul work, however, anywhere from 10 to 20 db of clipping will vastly increase your coverage range. The price you pay is a slight amount of distortion on local contacts. It won't hurt the intelligibility of your signal but won't be broadcast quality either.

We found both the no-clipping and the 15-db points and marked the shaft of R1 so either could be selected in a hurry. The way to find them is simply to get into a round-table and adjust R1 until everybody reports "nice audio" for you. This is somewhere near the zero-clipping point. Then when the going gets rough, turn R1 up until you're getting through without too much distortion at the other end, and you'll be near the 15-db point.

That sets you up and puts you on the air; the rest is up to you. For guidance, the following meter readings are normal on the original rig: Ig, 0.8 (8 ma); Ip, 0.66 (200 ma); Mod, 0.15 to 0.4 (50 to 120 ma); and Output, 0.5 or more depending upon antenna and vswr.

If you want to know a little more about how the various stages of the rig operate, here it is. This won't have much effect on the signal quality, but may be helpful if you have need to troubleshoot later.

The 6EB8 oscillator tube is a triode-pentode, with the pentode section oscillating and the triode doubling. The oscillator circuit is a Colpitts, with the feedback to sustain oscillation being developed across a capacitive voltage divider composed of the 10 and 100 mmfd capacitors in the grid circuit.

The ratio of these two capacitors determines the amount of feedback, and feedback may be increased by either making the 100 mmfd smaller of the 10 mmfd larger. The .001 is simply a bypass for the cathode resistor, and has no practical effect upon the circuit.

For vfo use, the rf choke is shorted out and the stage then becomes a tripler for 8 mc input. However, in oscillator service (which will be the more common use) the screen of the pentode acts as a virtual plate for an 8 mc oscillator, and the frequency is tripled in the

real plate circuit. L1 tunes the 24 to 24.667 mc range.

Link coupling from L1 to L2 in the triode plate discriminates against unwanted harmonics of the 8mc oscillator signal. The triode half of the tube doubles to 48-49.333 mc. Capacitor C2 balances out of the triode's output capacitance so that the C1-L5 tank is truly balanced; without C2 half of the next stage would get more drive than the other half.

The first 6360 is a tripler from 48-49.333 mc to 144-148 mc; it operates normally except that its cathode is brought out to the key jack and the screen is not bypassed. The screen bypass is not only unnecessary but actually reduces output for a 6360 due to the tube design.

The second 6360 is a straight-through driver to develop plenty of grid current for the 5894. Like the tripler, this stage is keyed in the cathode. Keying the exciter stages rather than the final reduces current through the key contacts. The potentiometer in the screen circuit of this stage controls its output, and thus the drive to the final.

The 5894 uses untuned grid circuitry, which must resonate *below* operating frequency. If resonated at or above the frequency of operation, oscillation is almost sure to result. Originally the final was neutralized, but this had no effect so the neutralizing circuit was removed in the interests of simplicity; the rig is complex enough anyhow!

The plate tank is a capacitance-loaded quarter-wave line. Its dimensions are not particularly critical as the tuning capacitor has a wide range. If it should tune too low, use less capacitance; if resonance is too high, use more. However, if you follow the dimensions within a half inch or so you should have no trouble.

In the audio circuitry, the 12AX7 is a conventional amplifier using contact-potential bias across the 4.7-megohm grid resistor for its first half, and cathode bias in the second stage. It drives the 12AU7 cathode follower, which provides a low-impedance source for the clipper.

The 12AL5 clipper acts just like a resistor in the line so long as the instantaneous audio signal voltage is less than the voltage applied to its plates, since both diodes are conducting. However, if the audio voltage goes higher than the plate voltage, the diodes cut off and limit the output voltage to the plate-voltage value. By selecting the plate voltage (through adjustment of R2) to be just equal to the voltage which will produce 100-percent modulation, overmodulation becomes impossible. This, in

turn, allows R1 to be turned up for "louder" audio without attendant splatter.

Because the clipping process generates audio harmonics which in themselves would create splatter, the clipper output goes through a filter composed of the choke and the two 270-mmfd capacitors. Any other filter design could be used but this is the cheapest and simplest we have found yet, and does a highly adequate job.

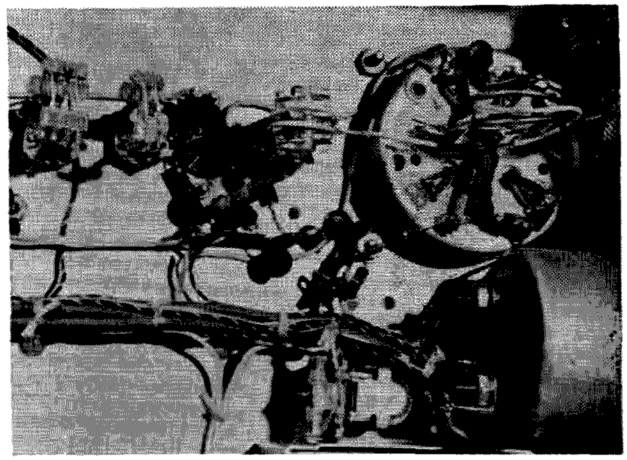
The second half of the 12AU7 used for the cathode follower is a "cathodyne" phase splitter. With equal-valve resistors in the plate and the cathode, it produces output voltages equal in amplitude but 180 degrees out of phase with each other. Voltage gain of this circuit is slightly less than one in either channel, so that an intermediate amplifier is necessary to bring the audio up to a level capable of driving the 807's to 60 watts output. Both the intermediate 12AU7 amplifier and the 807 stages are conventional push-pull audio amps.

The bias network in the 807 grid circuit allows operating bias to be selected for 50 ma resting plate current, while the relay associated with this puts 90 volts on the grids during standby to reduce power drain by cutting off the tubes. The other speech stages operate at all times.

The meter circuit may look a bit unusual; it allows use of standard-value resistors as "shunts." The 0-1 ma meter and the 1200-ohm resistor in series with it form a voltmeter with 1.2 volts full-scale reading. The "shunt" resistors in the metered circuits develop a voltage across them proportional to current flow; thus the 120-ohm Ig "shunt" develops 1.2 volts when 10 ma of current is flowing, while the 3.3-ohm Ip and Mod "shunts" develop 1.2 volts with 365 ma of current.

The meter movement is some 1600 volts positive to ground when measuring modulator plate current, but no trouble has resulted even though the case is shielded. The only trouble at all in the meter circuit has been the arc-over between switch contacts already mentioned, and this can easily be cured by interchanging Ig and Mod positions on the switch.

As mentioned earlier, this rig was designed for mobile use in conjunction with a power-supply originally installed for a Swan mono-



5894 final grid circuit.

bander, which provided 600 volts, 275 volts, +12 for filaments, and −90 bias. Actual voltage requirements can differ quite a bit from this, however. High voltage can be reduced as low as 500 without appreciable drop in output, and "low HV" can be anywhere between 250 and 400 (although at 400 volts, the value of the VR-tube dropping resistor probably would need to be increased; more than 150 ma would flow through the 30-ma tubes!). For home-station use the only problem would be the +12-volt supply necessary for the relays; we solved it by building up a small relay power supply separate from the filament supply line and running the filaments on ac.

If you don't happen to have a 5894 around the house, there's no reason why an 829B couldn't be used at approximately the same power level. Output would be a bit less, but the difference probably would never be noticed at the far end. Similarly, a 6CX8 can be used instead of the 6EB8 oscillator-doubler, but no substitution for the 6360's is recommended.

In the audio, the 12AX7 and 12AU7 tubes are so readily available that no substitution should be necessary. If you can't find a 12AL5, you can use a 6AL5 with a dropping resistor in its filament circuit. Instead of 807's, either 1625's (if you can find or make sockets) or 6146's could be employed. If you'll be satisfied with 80 percent modulation, 2E26's might be used. Any of these changes in modulator tubes, however, might require quite a bit of change in modulator screen and bias voltages, as well as transformer primary impedance. Try them at your own risk.

And in the meantime, whenever the band is open to Oklahoma or vicinity, keep an ear cocked for W5PPE around 144.010. He'll be using this rig—unless we come up with a better one in the meantime, but from the performance of this one, that's not very likely!

. . . W5PPE, K5JKX

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More on that Simple TR Switch

So much interest has been shown in the author's article in May 1963 73 on a simple T/R switch that it seems to justify a few further notes on theory and operation for those who are using the switch.

First, a correction is in order. The value of the cathode resistor is 25 ohms, one-half watt —not "25W" as was shown in the diagram. However, this value is not critical and anything up to about 150 or 200 ohms should work well.

Theory

An appreciation of the theory of operation of this handy little device will give some insights into possible adaptations and modifications.

Rf energy from the transmission line is picked up capacitively and fed to the cathode of the T/R switch. This rf voltage appears across the relatively high cathode impedance formed by the rf choke and the resistor. And the voltage drop appears at the grid of the tube.

Small voltages, such as those received from distant stations, are amplified in the switch as a class A amplifier, and fed to the receiver by capacity coupling to the plate of the T/R tube.

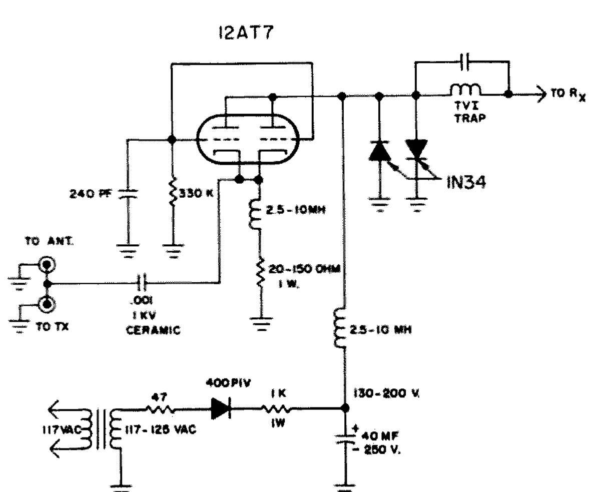

FIG. 1

Place .001 ceramic capacitor between plate-rc connection and 1N34's.

However, when the local transmitter is on, a large rf voltage appears at the grid, causing grid current to flow through the high value grid leak resistor. This produces enough grid leak bias (several volts) to shut off plate current flow in the T/R tube altogether. In this condition, the tube is a very poor amplifier, and very little of the transmitter output gets to the receiver—much too small an amount to do any harm. If reverse-polarity diodes are used across the switch output, this output voltage is clamped to a fraction of a volt, even in the event of a circuit failure of some kind. The capacitor paralleling the grid leak resistor is a "filter", which smooths the rectified rf to a steady dc bias. However, the time constant is short enough to "open up" the switch instantly when the transmitter is turned off.

Further receiver protection is offered by the high impedance output of the switch. This is capacity-coupled into the low-impedance input to the receiver—a very inefficient arrangement for transmitting damaging amounts of rf to the receiver.

QRO

Now, with all this in mind, it is obvious that a single dual-triode such as a 12AT7 should handle the duty for a full kw or more.

The cathode input to the switch presents a relatively high impedance to the low-impedance (50 to 100 ohms) transmission line. Therefore, very little rf power is absorbed by the switch from the feedline and most of this current flows through the cathode resistor and choke.

In actual practice, a single 12AT7 has been handling a full kw at W4MLE for nearly a year. The only breakdown was a filament burn-out.

A precaution in switches for high power rigs might be the use of a fairly heavy rf choke in the cathode, and a one-watt resistor. In the author's several models of this switch, receiving type 100 ma rf chokes of 2.5 to 10 mh were used with one-watt resistors with

only one failure. That was a resistor which went up in smoke due to a wiring error which put it directly across the feedline—in effect, making it a dummy load for 750 watts of rf.

TVI

Shortly before the previous article appeared in print, a TVI complaint cropped up which traced back to the T/R switch. Operation on 20 meters produced herringbone and bars on the TV set next door on channel 6.

There was no TVI from operation on any other band. And even the 20-meter TVI disappeared when the filament to the T/R switch was turned off.

The trouble was traced to the switch output to the station receiver. It was the receiver which radiated TVI generated in the switch! It was cured with a simple trap between the switch and the receiver line.

The TVI was not produced by the 1N34 diodes. It was present whether they were in the circuit or not.

Power Supply

The power supply for this switch can be simplified by using a resistive-input RC filter with a single capacitor if space is a prime consideration. Too little filtering, however, will result in a rough note on all received signals. See Fig. 1.

SWR

Referring again to the discussion of the theory of operation, it is apparent that a high VSWR on the transmission line will result in relatively high rf voltages being applied to the cathode of the T/R tube.

In a 1 kw class C, CW amplifier feeding a 70-ohm transmission line with a 1:1 VSWR, there will be a maximum of about 200 to 250 volts across the transmission line, assuming 700 to 750 watts output. Double that for plate-modulated AM or 2kw PEP SSB.

As the VSWR increases, however, these voltage maximums rise very steeply. A 3:1 VSWR should give peak voltages exceeding 1500 (2kw PEP) across the feedline, and presented to the switch input.

This results in considerable stress on the input capacitor to the switch, and presents the 12AT7 grids with peak voltages and currents which they weren't exactly designed for.

Even so, there has been no indication of component failure so far in any of several such switches used by the author, despite several instances of transmitter tune-up on the wrong antenna, with astronomical VSWR figures.

. . . W4MLE

A versatile signal grabber for 2 meters

The Disguised TWIST

"Tut" Tuttle WA6LUM

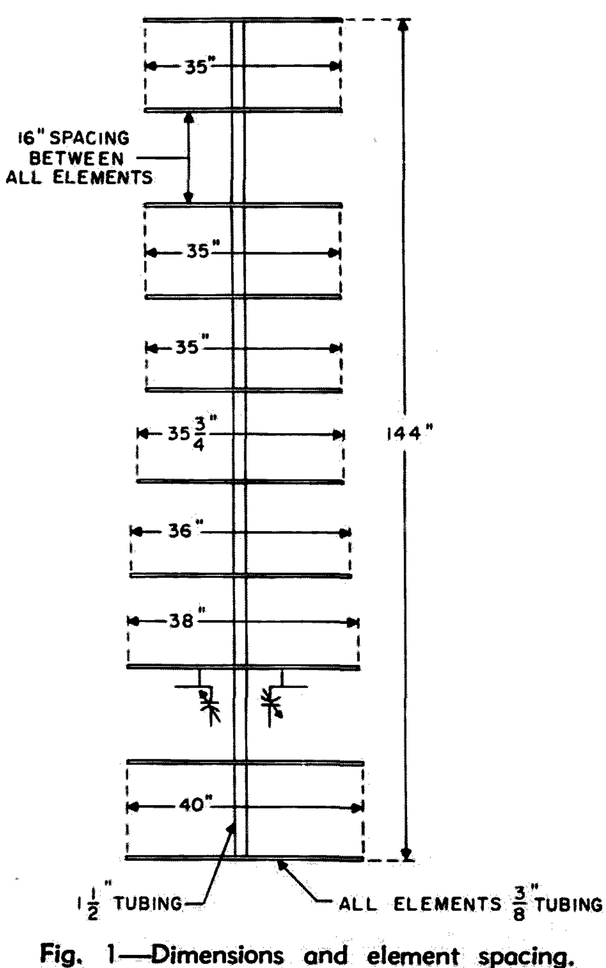

Fig. 1—Dimensions and element spacing. Elements in opposite plane are identical. See Fig.2.

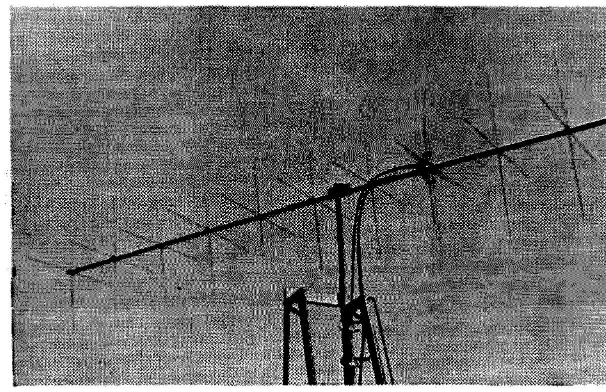

Fig. 2—Complete "twist" on 16' test ladder. Note uniform 16" element spacing and line matching elements.

In some areas the two meter band is a hodge-podge of vertically, horizontally and spirally polarized signals. Available antennas work very well in one mode but always discriminate against others. The "Disguised Twist" is an attempt to provide a single array that would give optimum results utilizing vertical, horizontal, clockwise or counter-clockwise spiral patterns. The pattern is easily selected with a twist of a knob at the control point.

The antenna was designed and built by Buddy Alvernaz W6DMN, Dave Mauro W6LXK, and Rudy Stefenel W6OQW, as a joint effort. The boom is 1½" aluminum TV mast, 13 ft. long. The elements, cut to length as shown in Fig. 1, are mounted on 16" centers as shown in Fig. 2. ⅜" aluminum tubing from scrapped TV antennas was used for the prototype elements. The driven elements are T matched to 200 ohm twin lead (K-200). Fig. 3 shows the matching elements and their plexi-glass mounting plate in place on the boom. The K-200 feedlines between the switch box and the driven elements are exactly one half wave long, as shown in Fig. 4. When the antenna is used to give a spiral pattern, these feed lines are in parallel with a reflected impedance of 100 ohms. This is re-matched to the 200 ohm transmission line through a matching stub at the switch box as shown in Figs. 4 and 5. In spiral modes an extra ¼ wave length of K-200 is switched in series with one or the other of the ½ wave lines between the switch box and the driven elements. The direction of spiral is determined by which line has the added length. Again, see Figs. 4 and 5.

The switching is accomplished with three Jennings RB-3 vacuum relays. The switch box containing the relays, matching stub and ¼ wave phasing section (see Fig. 5) is mounted on the mast about 30" below the

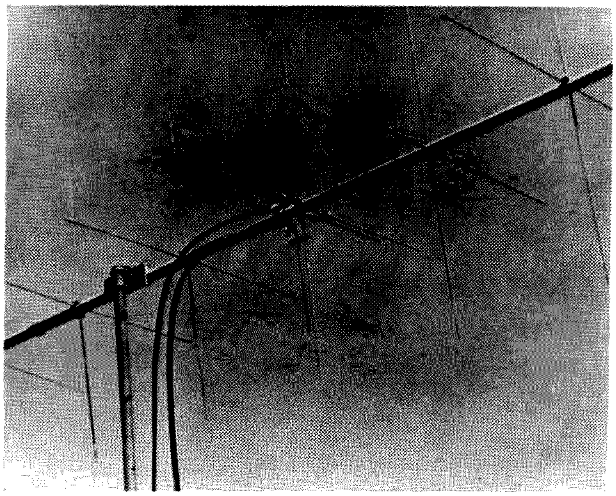

Fig. 3—Details on matching units and feed line mounting. Switch box not shown.

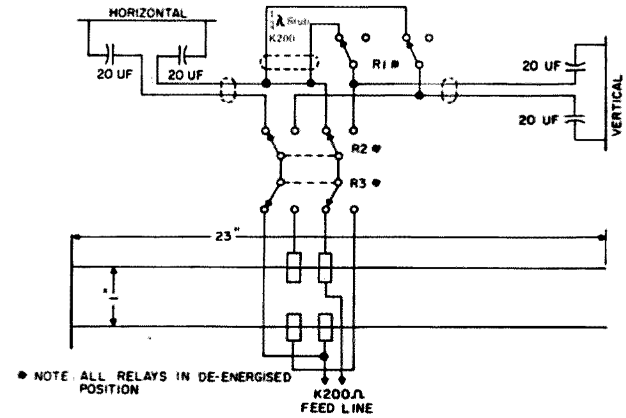

Fig. 5—Switchbox circuitry showing relays and impedance matching circuits. All relays are shown in de-energized position.

boom. Several heavy coats of acrylic spray were applied to both the antenna and switch box before they were finally erected.

The dimensions of the various matching elements were determined for a frequency at the low end of the band through careful cut-and-try, with the antenna mounted on a 16 ft. ladder as shown in Fig. 2. A Bird Model 43 VSWR bridge was used in this time-consuming operation. It is very important that all elements be carefully matched, with a minimum VSWR. Mis-matching can cause some mighty weird patterns.

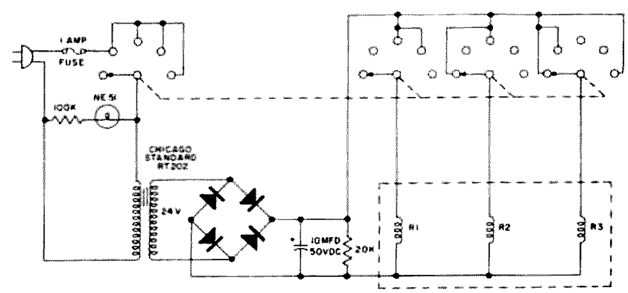

Fig. 6—Control box circuit. Relays require 500 ma at 26 volts dc. An inexpensive bakelite wafer switch does controlling.

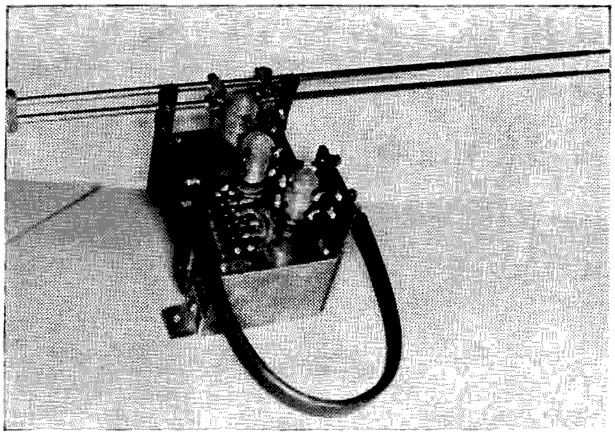

Fig. 4—Switch box details, showing 100-200 ohm matching stub and phasing section with their associated relays.

The control box, Fig. 6, consists of a 26 vdc power supply for the relays and a four deck wafer switch for control. Five switch positions are provided: off, horizontal, vertical, clockwise spiral, counter-clockwise spiral.

The "Disguised Twist" has been in service for several months at the Sidewinders Radio Club (Jennings Radio Mfg. Corp), with some unexpected results. Generally the best results are with the twist matched to the mode of the station being worked. At times a flip to cross polarization will raise signals in both directions. At other times and on the same path, a spiral pattern will give best reports. The antenna is still under study and more dope will be forthcoming at a later date.

. . . WA6LUM

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Arlington 2, Va.

The Backward Upsidedown Halo

I had just made a purchase at the friendly neighborhood radio store and was returning to my car, when a little red Volkswagen squeezed into a parking space adjacent to mine. As I was edging my way into the driver's seat, being careful to avoid a collision between my door and the little red Volkswagen, the driver of said same car was eying my halo. After several minutes of maneuvering, I managed to shoot through—all this oblivious to my preoccupied friend. I slammed the door a little harder than usual. Apparently I broke the trance, because he yelled over, "Hey, buddy, didya know your halo's turned around?"

"Yes, I know. It keeps the capacity. . ."

"Not only that, it's upside-down. What are ya, some kinda nut? What kinda SWR do ya have anyway?"

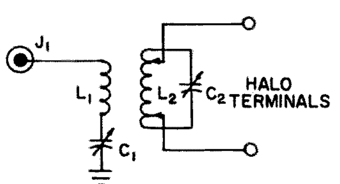


FIG 1

Parts List

C_1—75 mmfd variable; Hammarlund APC-75
C_2—50 mmfd variable; Hammarlund APC-50
L_1—3 turns wound around L_2 (close spaced)
L_2—9½ turns of #10 or #8 wire wound on a ⅝" form. Coil length 2¼"
J_1—SO-239

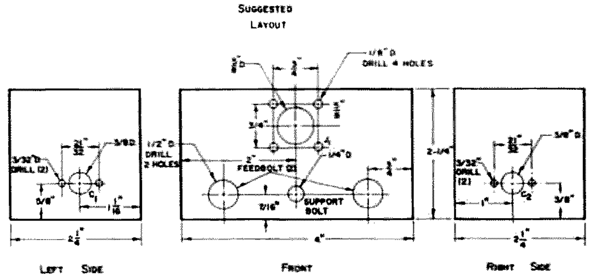
Well, what do you say? After many frustrating hours of making and adjusting quarter-wave feeds and autocoils, halo right side up and upside-down, I was ready to say yes to his first question. I grudgingly admitted that my SWR was about 3 to 1. Certainly this didn't convince him of my sanity. Then and there I decided to start all over and try something new in the line of halo matching. Not only did I want a decent SWR, but also, I wanted a match which was adjustable—easily adjustable. This means no more settings which looked perfect until you stepped five feet away! And thirdly, I wanted a system which would fit into a compact container. With the fact in mind that anything I did to the halo would be an improvement, I left my friend mumbling to himself something about "what this world was coming to," returned home, and started digging into the junkbox. Here is the result.

The Matching System

The matching system is made up of two tuned circuits link coupled to each other. One tuned circuit is in series with the 50 ohm feedline and controls the amount of coupling. The other is in parallel with the halo and determines the operating frequency. Rf is tapped off this second tuned circuit and fed to the halo. This arrangement matches the two impedances and effects an unbalanced-to-balanced match as well. Because the input of the matching system is a tuned circuit the length of the feedline is not important, as it is in a quarter-wave matching system.

Construction

The unit is enclosed in a 4¼" x 2¼" x 2¼" minibox chassis. A larger chassis can be used if more room is desired.



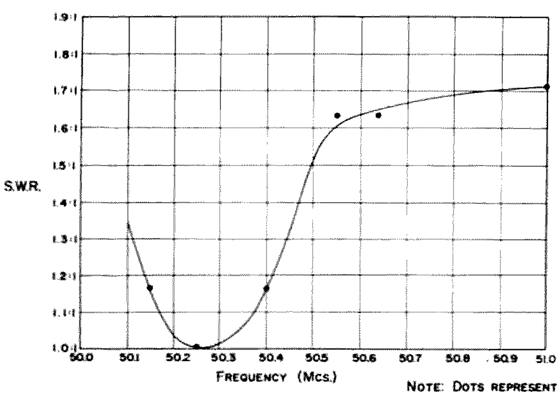
To mount the minibox the halo must be flipped over, so that the driven element is on top. ½" is sawed off the top of the halo mast to allow clearance for the SO-239 antenna jack. Incidentally, the halo operates just as efficiently upside-down as right-side-up. The minibox case is supported by the higher of the two halo-mast bolts. 1¼" on each side of the hole for this bolt are ½" dia. holes which pass the feed-bolts. Large fiber washers are used to separate the feed-bolt nut from the chassis.

Ground lugs mounted on each feed-bolt provide a means of connecting the halo to the taps. Small alligator clips are used as taps for the coil.

CI and C2 are not particularly critical, and many capacitors of nearly the same value may be substituted. It is important, however, that

both stator and rotor plates of C2 be above ground. The APC capacitors recommended in the parts list are tuned with a screwdriver. They will serve the purpose nicely since, once set, it is unlikely that they will be tuned again.

S.W.R. vs Frequency



Note: Dots represent actual S.W.R. taken at the respective frequencies

Operation

With an SWR bridge in the feedline, position the taps of L_2 so that they are 2 turns each side of center. Place the cover on the minibox, and adjust C_1 and C_2 for the lowest SWR. Since tuning one will affect the other, first tune C_1, then C_2, then C_1, etc. Repeat this procedure, if necessary, changing the tap settings each time. At the resonant frequency of the halo (50.25 mc in my case) the SWR is very near 1:1. Fig. 2 shows how the SWR varies across the first megacycle of six meters. A word of note: As a matter of practice I keep the halo capacity plates as far away from the car body as possible. This is to avoid detuning effects. Any metal near the capacity plates will change their capacity and thus the operating frequency. This method is quite the opposite to the conventional method (having the ring extend forward). I have found that on my car there is little difference, if any, between the two positions. If you want an "extra margin", however, the halo ring should extend to the rear. On some vehicles, such as a station wagon, where the capacity plates are less than a foot or so from the body, it may be absolutely necessary to mount the halo "backwards", if detuning effects are to be avoided.

Conclusion

The tuning system has proven to be quite an improvement over past matches. This was unmistakably shown during a visit to my former QTH in the hilly section of Northeast Pennsylvania. Stations were able to copy me solidly, without interruption, along routes where I previously suffered fading and low signal strengths with the quarter wave match.

Since the tuning system is easy to adjust there is no problem if I want to operate with a 1:1 SWR on any other part of the band than 50.25 mc. All I need do is adjust the capacity between the two capacity plates, retune the match, and I'm in business.

The aluminum box has proven to be a blessing too. All connections, including the direct connection to the halo, are protected from rain, wind, and dirt. That means no corrosion.

And best of all, I no longer become frustrated when people, like the gentleman in the Volkswagen, ask me what is the SWR of that backward upside-down halo.

. . . WA4INJ

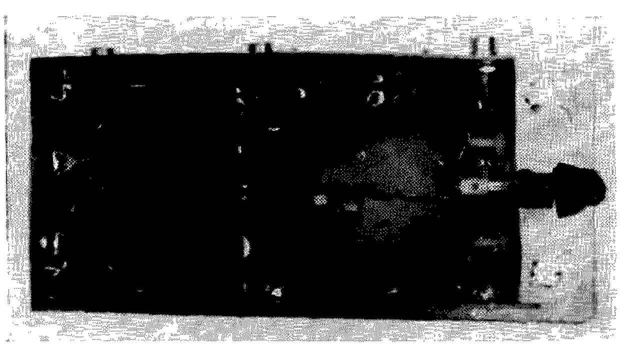
Here's the easy way to experiment on VHF.
Build an effective cheap UHF front end in half an hour.

VHF-UHF Mixers

Bill Hoisington K1CLL
Peterborough, N. H.

Introduction

In some of our notes on frequency multipliers we have mentioned listening to the output. With *transistor* multipliers this can be important. Of course you can also look, or measure. In fact, on certain projects I like to do all three at once. A change of note, a little overmodulation, a waveshape change, spurious signals, etc., can be heard as soon as they happen, looked at on the scope, and measured on a meter.



VHF Detector.

There are a series of handy-dandy little units which you will find very useful for picking up such signals including the desired ones, and for watching small amounts of rf volts like from transistor multipliers before they are full-grown. I will describe some for lower frequencies also because they will do things which the usual run of grid dippers do not, such as serve as mixers or video detectors.

Of particular interest I believe, should be the 400 to 500 megacycle unit, which makes an awfully nice mixer for the 432 band, and also for amateur Tee Vee.

General Purpose Untuned Detectors

Fig. 1 shows a little gadget of great utility around the shack bench. The input capacity, the choke, the rf bypass C3, and the dc load, R1, should be of different values for different groups of frequencies for best results. In the *if* regions you can use .001 mfd for C1. In the HF range 3 to 30 megacycles, use a 7-45 mmfd mica trimmer and from then on up use a small .8-7 mmf one, with the adjusting screw end connected to the choke rfc. That is, leave the smallest amount of metal connected to the test point. Also, use "pee-wee" alligator clips. C2 is a ground isolating capacitor. Lets you connect the gadget across a plate coil with B plus on it. (Not a kilowatt tho!)

Rfc can be a Tee Vee peaking coil for use on the *if* frequencies. I have even used an old audio transformer secondary when using this gadget around 2 kc. For the HF regions use a "standard" 2.5 mh choke. For the UHF region wind your own. About six pie sections of 5 turns each no. 34 to 36 wire is good, on a ⅛ inch form. Put your finger on it once in a while if in doubt. If that does anything except decrease the output meter, use more wire!

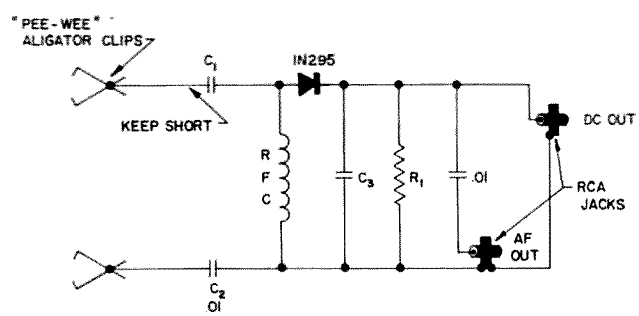


FIG. 1

Fig. 1—General Purpose rf Detector

R1 is not really needed if you only use a meter with this unit. The moment you want to listen though, it is necessary. Anyway, you ought to get familiar with what makes a good AM diode detector-demodulator. Around 300k is good. For "video," R1 gets real small.

C3 also depends on usage. For measuring you can even slow down your meter action if you use many mfd's. Seriously, a good value

for AM voice demodulation is 500 to 1000 mmfd. You leave this in for most everything except video. You might use as little as 10 mmfd there. C4 is just an af coupling. Use .01 for video; this may go *up*. Remember, 30 cycles? So, enough on this one. You can see there is quite a lot to even the simplest gadget, if you want to cover the foul lines as well as left field.

VHF Tuned Detectors and Mixers

This section, like the preceding one, will be kept short, as the main interest is considered to be in the 400 megacycle region, where low-cost, easily handled, good tuning, working units are not too well known as yet.

Fig. 2 shows the essential details. A unit useful from 6 to 2 meters is shown first mainly for description purposes, although when a special frequency detector or mixer is needed for VHF it is very nice to have one handy. Some interesting experiments can also be done on wire wound coils versus "helix" coils.

The box, not quite yet a trough line, is made of standard (for this experimenter) copper-clad bakelite, and can be fitted with a top cover which does not change results much except to cut down rf leakage. All rf and *if* components are kept inside and shielded, with feed-through and leakage in mind. There are two types of leakage involved; the first concerning the rf under investigation. When magnetic or voltage probes are used on the input jacks for circuit, antenna, harmonic or parasitic energy checking, etc., it is necessary to avoid direct coupling into L1 itself. Otherwise the probe in use will not be able to tell the proper story about what is going on. Also, antenna experiments are often run with long cables so it is of considerable interest to avoid direct pick-up, even of weak signals (and ignition) on L1.

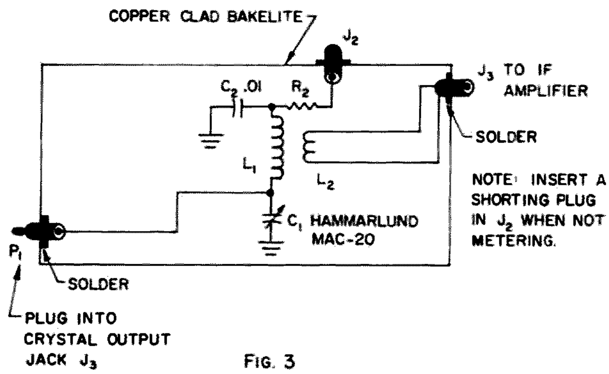


FIG. 3
IF OUTPUT CIRCUIT

Fig. 3—if Output Circuit

The second leakage is of course at *if*. Note the very simple arrangement to prevent this. The blocking, or rf bypass capacitor C4 is built into the crystal holder (it actually is the crystal holder) and is on the *inside* of the box and close to the output jack. The capacity of this unit is of some interest as it forms part of the tuned *if* output transformer. A word here about crystal mixers. Every time I have used the circuit of Fig. 2 it has worked right away. Refinements can be added or a strictly fixed-tuned converter can be used, but this unit can be made to do almost anything in the VHF-UHF mixer line, especially as a *tunable* front end.

C4 also serves as a dc bypass capacitor when a meter is plugged into J3 for measuring purposes, although you may add more capacity to C4 if you use the unit for dc only.

Note that several circuits can be plugged into J3. The dc crystal current is present, for metering. Different *if*'s can be plugged in, as needed, outboard *if* pre-amps can be tested, etc. Fig. 3 shows a "crystal-*if* output box" which is very handy. P1 plugs directly into J3 of Fig. 2. C1 should be large enough to tune L1 to the *if*, including the capacity of C4, and the jack and plug. C2 and C3 may be .01. R1 is "what suits the particular crystal" and the excitation used. I have generally found this to be between 1K and 3K.

Caution! When using high *if*, such as 52-53 megacycles (my old favorite broad-band ASB-7), P1 and J3 leads must be kept real

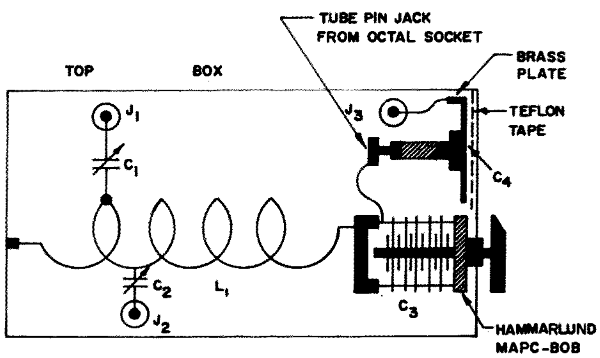


FIG. 2

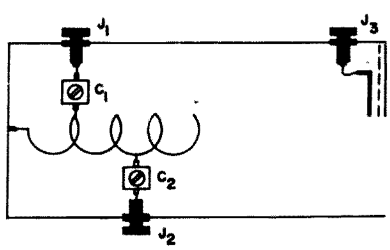
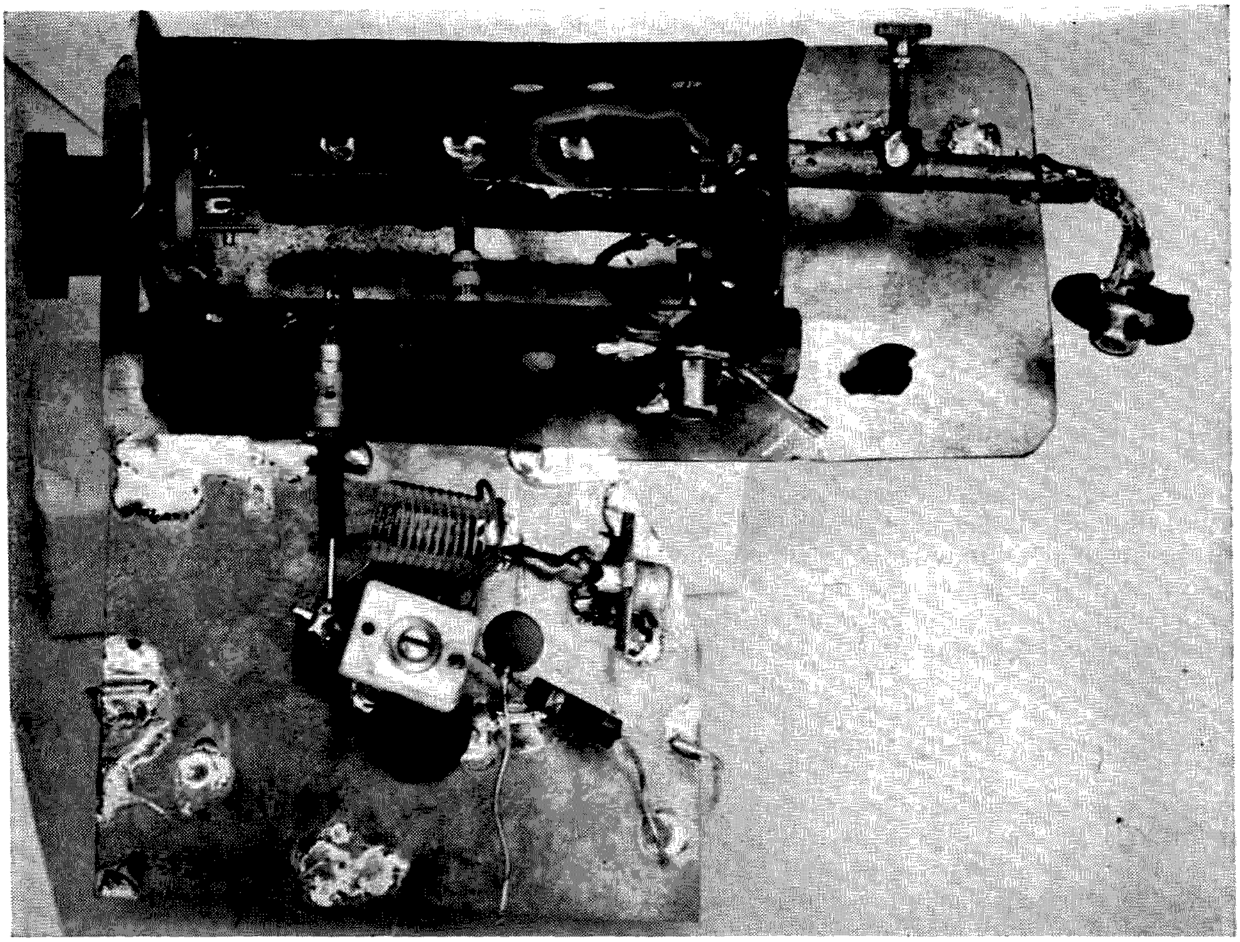


FIG. 2B

Fig. 2—Side View, VHF Detectors
Fig. 2B—Top view



400-500 mc detector-mixer at top. IF output at bottom.

short. 50 megacycle circuits do *not* like to be tuned through long leads. You will be baffled by the most peculiar sort of mushy, backward, (just plain lousy) tuning you ever saw. Like when you have a FB capacitor with a couple of good clip leads about four or five inches long, and it works fine on tuning coils around 5 to 10 megacycles, but up on 6 meters it just goes Blah! Of course you can build the *if* output circuit in another box right alongside of the Fig. 2 box.

You may not like all this experimentation at every step, but if you do go through with it you *will* learn some practical matters about VHF and UHF detectors and mixers! We are actually not getting into the theory of mixing at all. This *really* gets deep if you do delve into it. I have several large books (one at $12.50 on this one subject alone.

Just for fun, and to check a crystal mixer on HF which I don't seem to recall having done before, I put into the box of Fig. 2 a 32 turn coil of 16 turns to the inch airwound, for LI, tuned by a 50 mmfd capacitor for C3. It tuned from 12 megacycles to 35 megacycles and sure pulled in 20, 15, and 10 meter amateur stations (and a lot extra as well) using a signal generator for the local oscillator, plugged into J2.

The *if* was tuned to 3.49 megacycles and used the circuit of Fig. 3 with two inches of 32 turns-per-inch *if* coil tuned with about 140 mmfd for C1.

Incidently, C4 in Fig. 2 was tested to be 75 mmfd. That is, with a somewhat loose brass plate for the crystal holder-output capacitor asembly. Two layers of sticky Teflon tape were used for the insulator of C4.

With 11 turns of 6 turns-per-inch airwound coil for L1 of Fig. 2, the circuit tunes to 6 meters. With 4 inches of straight copper wire for L1 it tunes from 75 to 200 megacycles, still using the 50 mmfd capacitor. Now watch! Just taking out the straight heavy wire and putting in copper strap (also 4 inches long) in its place, changed the tuning range to 80 to 250 megacycles. See also later paragraph on "Helix" coils.

Putting in a small Johnson type 9 mmfd capacitor, the same circuit tunes from 165 to 285 megacycles using a 5¼ inch strap 1 inch wide. Putting a top cover on the box, the range went to over 300 megacycles but did not change power much. Use top cover for

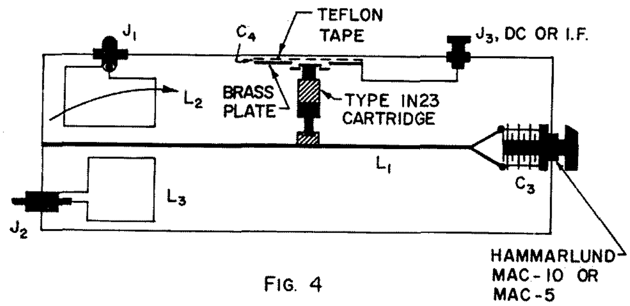


FIG. 4

Fig. 4—400 to 500 mc Detector-Tuner-Mixer

maximum shielding, I guess.

Now for wire versus "Helix" coils. Of course, a Helix Coil sounds a lot more impressive than a strap coil. Suit yourself. The circuit of Fig. 2 lends itself well to this check. L1 has only two major connections, except for C1 and C2 which are easily soldered on. As an alternative, J2 (or J1 also, see also the UHF tuners) may feed a loop coupling to L1. In fact, for best tuning range, use coupling loops. See Fig. 4. As an example of wire versus strap, L1 was made of three turns of heavy copper wire, no. 14, and tuned 120 to 210 megacycles using the Johnson 9 plate capacitor 9 mmfd, with a box 3½ inches long by 3 wide by 3 deep. Just changing to three turns of ¼ inch copper strap makes the tuning range from 160 to 280, with the 220 band right in the middle of the range. The copper strap coil is about 9/16 O.D. and is about an inch long, with some 3/16 spacing between turns. It is air supported and there are about ⅜-inch straight copper straps as leads on each end.

And Now For 432

There have been quite a few circuits shown for 400 megacycles. Some of them show various kinds of small coils, loops, and what have you—attached to a crystal mixer, in one way or another. Plenty of tube mixers have also been described, but here we will concentrate on crystal diodes since they are simple and effective. At any rate, my thought here was to make up a tuned rf detector that would serve also as a mixer, be sure-fire and fool-proof, and be low in time and cost demands. I have already made one that works FB as mentioned above, but is a coaxial unit.

Fig. 4 shows the result of this easier-to-make trough-line venture. It tunes from under 400 to over 500 and covers RADAR, amateurs, RADAR, mobile and CB bands (UHF), and takes in the first few UHF Tee Vee channels. It works FB as an rf power detector and also as a mixer, *now*, but it has been a battle to get the latter fool-proof. First, as a detector. No trouble here. Again, the influence of the wide strap for L1. Using a one inch wide strap for L1 pushed the frequency quite a way up and increased the Q. Using a regular "store-bought" tuning capacitor for C3, a Johnson 5 plate type (I believe it is about 9 mmfd at maximum) it tunes excellently, going from under 400 to over 500 megacycles. It pulls in Radar (of course) with only an af amplifier plugged into the output jack. It works a meter FB, showing several volts dc from a small transistor UHF signal generator. (What's that? you want one of those too? OK, but later).

The position of the two input jacks and their taps on the main tuning strap, Fig. 4, was carefully tested. Be careful on this! A small loop of wire at L2, grounded at one end and terminated by an *open* jack resonates right in the middle of the band. (See also later.) (About variable coupling loops.) As a mixer it handles very well also. With attention to the antenna and oscillator couplings and my old favorite broadband *if* hooked onto the output, that is. This is an ASB-7 using 55 megacycle *if* for the first section, then changing to 15 megacycles. It was built by G.E. during WW2 and still works good. Using a transistor local oscillator tuning 450 to 550 megacycles, the ensemble makes a very interesting tunable receiver for the range 390 to over 500 megacycles. If you want one! I did.

An interesting item concerns loading with the two inputs variable as shown in Fig. 4. A signal on J1 produces 3 volts dc out of

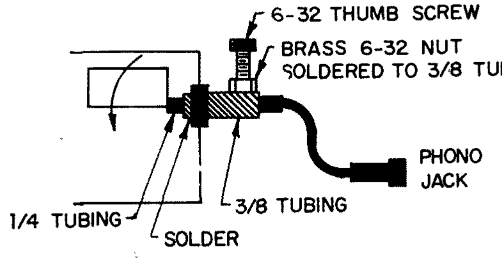


FIG. 5

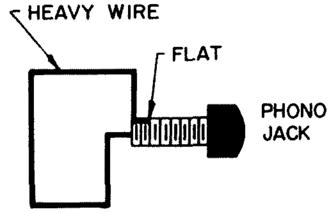


FIG. 6

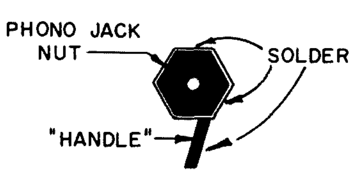


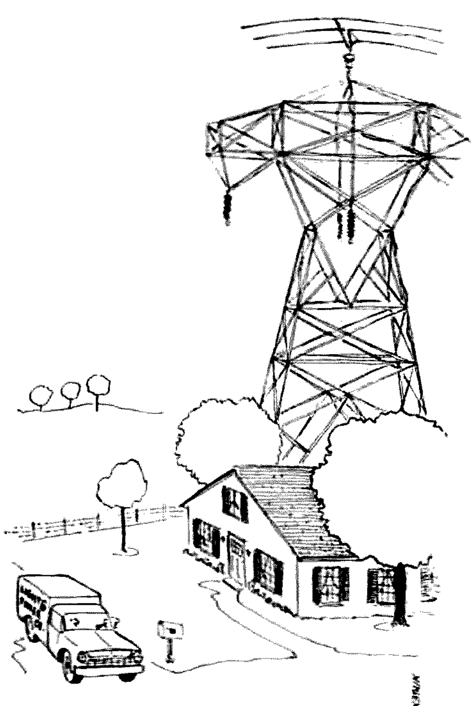
FIG. 7

Fig. 5—Coax Coupling Loop detail
Fig. 6—Phone Jack Variable Coupling detail
Fig. 7—Locknut detail

J3. That is, when the J2 loop L3 is *decoupled.* See also Fig. 5. When a resistor is placed across J2's output cable and L3 is coupled *into* the magnetic field of L1, the output voltage drops to 1½ volts. A matched 432 megacycle antenna has the same effect. As a mixer, the two variable coupling loops work like little charms. With the set up I tested. The oscillator loop needed to be only about ½ coupled, that is, at about 45 degrees. One thing was sure, you could now maximize the antenna and the oscillator injection coupling. This was using a tuned transistor local oscillator.

Antennas get to be a problem with 100 megacycle tuning range. Such things as log-periodic antennas do exist, of course, but as an amateur DX fanatic I like a narrow band high-gain job. Take your choice. Using an indoor dipole, several very loud 450-470 megacycle stations were heard—probably in the mobile, business, or UHF CB bands. My main interest is, of course, on 432 for good old DX, when and if! For ATV this unit should be very FB. Bandwidth can be adjusted, antennas matched, video and sound outputs tuned up, etc. That, of course, is still another story. We do have also a good strong power oscillator for 440 (see 73 Mag.). These two should be ideal for good power on ATV.

Some details now on the two variable



"...HANK... I THINK IT'S ONE OF OURS..."

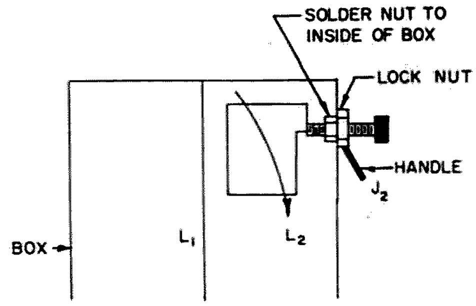


FIG. 8

Fig. 8—Phono Jack Variable Coupling detail, top view

coupling methods. Mechanical, mostly. Fig. 5 shows one method of obtaining variable loop coupling. A one inch section of ⅜ inch copper tubing is drilled out for a 6/32 thumb screw and a brass nut is soldered onto it. A two inch long piece of ½ inch copper tubing is prepared with RG58/u inside, first removing the black cover. Feed it into the ¼ inch tubing and remove about two inches of the tinned copper brain. The insulated center wire comes out of the ¼ inch tubing just inside the rear wall of the box of Fig. 4. It forms a loop roughly ¾ inch long by about ⅜ wide, and should turn freely in the space between L1 and the inside of the box. From tests, this loop could be even smaller.

The second method tried goes quicker and works the same. Suit yourself. A phono jack, single mount type, is prepared by filing a slight flat on the tip of the thread. See Fig. 6. This serves to solder the ground return side of a loop. See also Fig. 4 again. A phono jack nut is soldered to the inside of the box wall, over a ¼ inch hole in the same wall. Another phono jack nut has a heavy wire loop soldered around it to form a handle for using it as a locking nut on the outside of the same box wall. See Fig. 7. The whole shebang is shown in Fig. 8. Looks kinda crude but works like a charm. Where can you *buy* one like it for 432? You have to file everything nice and flat on that assembly, by the way, or you can't get both nuts on and working right.

Conclusion

A series of tuned rf dectectors and mixers has been described, with particular emphasis and detail on a practical 432 megacycle tuned crystal mixer. This mixer can form the heart of a low cost 432 receiver.

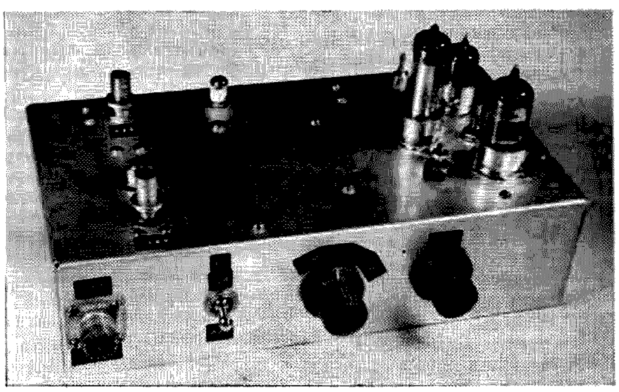
. . . K1CLL

Photo Credit: Joe De Young WA6CQL

Jim Kennedy K6MIO
2816 E. Norwich
Fresno, Calif.

UHF Signal Generator

If operators on our sparsely populated UHF bands were obliged to wait for the appearance of an air signal on the band in order to align a converter or tune up a preamp many would probably grow long grey beards (apologies to Sam Harris) before the converter or preamp was ready to go.



Front view of signal generator.

Having worn out several razor blades over this problem myself, I set out to seek a solution to the problem.

Investigation revealed four possible solutions: buy an electric shaver, convince more hams to build UHF transmitters, quit ham radio forever (again?), or build a signal generator.

All of these were tempting but the last was finally decided upon.

Several requirements were the basis for the design of this signal generator: operation on both 432 mc and 1296 mc, high stability e.g., crystal control, variable rf amplitude, provision for insertion of various types of modulation, and lowest possible cost consistent with satisfactory operation.

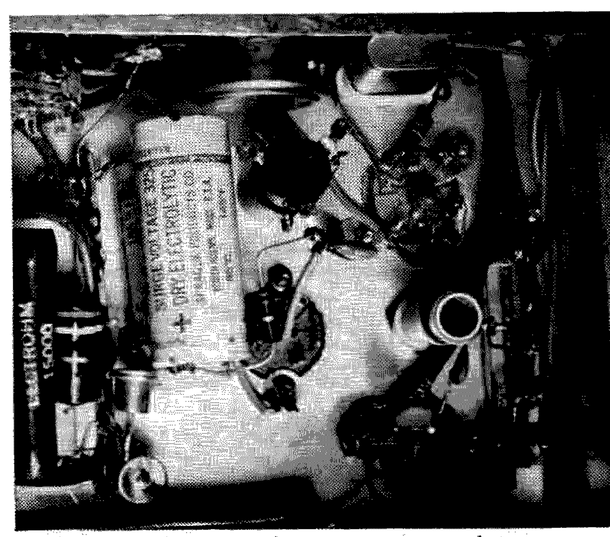
I had a 27.005 mc overtone crystal left over from a brief period of disillusionment about CB and, since 27 times 6 is 432 which times 3 is 1296, this seemed a likely place to start.

Fig. 1 shows the final result. The overtone oscillator is voltage regulated and is left operating at all times when the generator is on. The crystal is mounted underneath the chassis to protect it from rapid temperature changes from drafts, etc., further enhancing the stability.

The use of diode multipliers at 432 mc and 1296 mc greatly simplifies developing UHF rf.

Direct coupling the modulation into the cathode of the last vacuum tube multiplier provides a modulation input that will accomodate almost any signal from audio to video, or even pulse.

A four position mode switch on the front panel allows the choice of carrier, no carrier, carrier with 60 cycle modulation and finally carrier with external modulation.



Closeup showing the oscillator and vacuum tube multipliers.

Construction

Building the unit presents no special problems except getting it all under the chassis. The 5 x 9½ x 2½ chassis doesn't leave much useful room to spare, but it does make for a very compact device.

The lengths of the diode multiplier tuned lines were determined primarily by the space available and bear only the slightest relation to the wave lengths involved; hence, it was necessary to pad both lines with additional capacitances in order to resonate them properly.

Both lines were folded from 1/32 inch brass sheet stock. The inner conductors are made

from ¼ inch brass tubing. The 432 line is 1" x 1" x 7". The input diode is tapped onto the inner conductor 1¼ inches from the other end. The signal output loop is about 1¼ inches long. The output diode is tapped 2 inches from the loop end of the line.

The tuning capacitor is made by soldering a 10-32 nut over a hole in the middle of the line shell. This provides the threads for the 10-32 screw which actually serves as the capacitor.

Round ½ inch disks are soldered to the bottom of the center of the inner conductor and to the end of the turning screw to provide additional range.

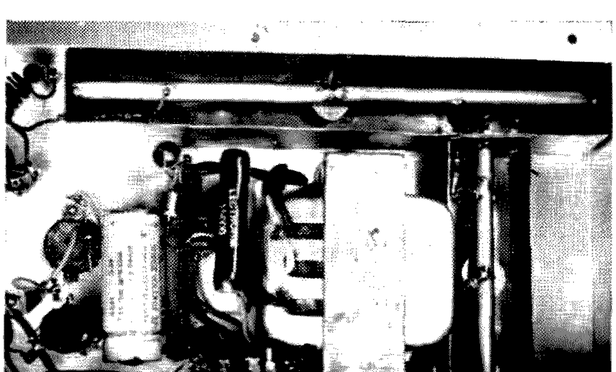
The 1296 line is similar except it is only 3⅝ inches long. The multiplier diode is tapped on the inner conductor ⅝ inches from one end. The signal output loop is about ¾ inches long and is located at the other end of the line. The tuning capacitor is identical to the one used in the 432 line.

The 15K 10 watt resistor in the carrier OFF position limits the no load voltage from exceeding the ratings on the filter capacitors.

Operation

The tune up of the tube stages can be easily accomplished with a grid dipper. The UHF stages should only need to be peaked with a converter and receiver.

Shields on all tubes and a bottom cover on the chassis are important requirements if stray leakage at the signal frequency or lower harmonics is to be eliminated as a possible source of measurement error. These were removed for the photographs but are always used in practice.



Closeup view showing details of diode multipliers lines.

For best results it is a good idea to employ a 50 ohm (or 75 ohm as the case may be) pad between the signal generator and the equipment under test. This will insure that the generator will appear as a resistive load as much as possible. This is necessary if the generator is to duplicate the conditions presented to the receiver by a good antenna.

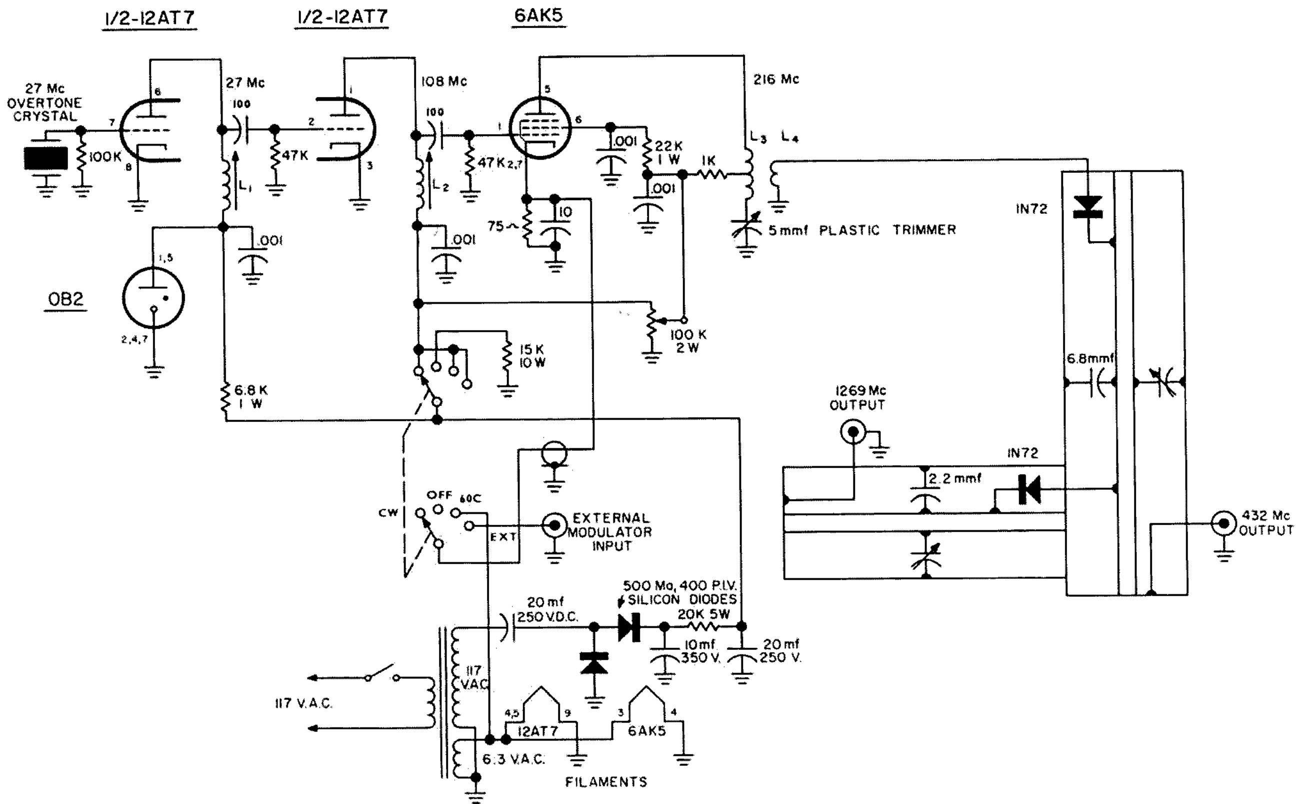


FIGURE 1

L1—10 turns # 28, 3/8" slug form.
L2—3 turns #28, 3/8" slug form.

L3—10 turns #18, 1/2" dia.
L4—3 turns #18, 1/4" dia.

This pad can take many forms. The two easiest ways to make one would be to use sufficient lengths of some lossy coax. At 432 mc higher, 20 or 30 feet of RG-58 (or RG-59) seems to be quite adequate for most applications. The other approach would involve building a conventional resistor pad into a male and female BNC connector soldered back to back. Fig. 2 shows such a pad.

Aside from receiver testing, this device has several other uses to which it can be put. It is also useful as a signal source for antenna tests and it may be used as frequency standard.

This last use can be of great value at UHF because of the persistent problem of crystal tolerance versus frequency multiplication. A converter can easily be 40 or 50 kc or more off of the indicated frequency at 1296 mc. This can be quite a problem if you are hunting for a moonbounce signal through a 5 cps filter.

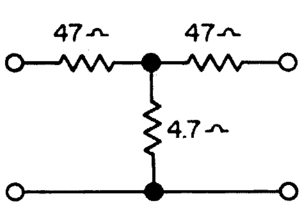


FIGURE 2

Fig. 2. 20 db 52 ohm pad. Resistors mounted in BNC connector.

Though not shown on the diagram or in the pictures, it was found that a 50 mmfd variable capacitor connected across the crystal was sufficient to reduce 27.005 mc to the 27.000 . . . mc required to put the generator on 432.00 . . . and 1296.00 . . . mc. It will probably be necessary to retune the oscillator plate circuit for best operation; some loss in output will be encountered but this should not be a serious problem. However, if such operation is contemplated, it might be of some advantage to obtain a 27.002 mc crystal and employ a smaller variable capacitor.

In order to make the frequency standard really something of a standard, a 1 mc calibration oscillator should be employed. Some harmonic of the oscillator (5 mc, 10 mc, etc.) should be zero beated against WWV. The signal generator should then be zero beated against the 27 mc harmonic of the 1 mc calibrator—presto!—a 432-1296 mc frequency standard.

Though there are many refinements which can be made, the unit described has done a yeoman service in all the varied tasks asked of it.

. . . K6MIO

L. E. Lee K5BLF
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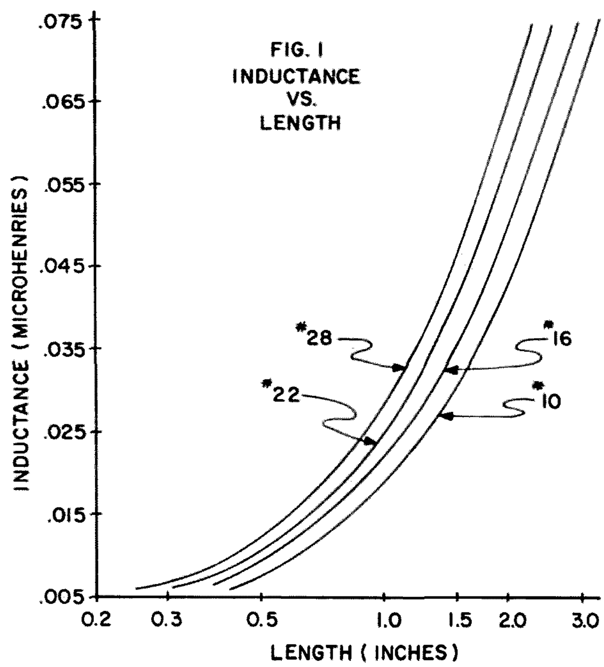
Tulsa 45, Oklahoma

Just a Piece of Wire?

One of the biggest bug-a-boos in the construction of VHF and UHF gear is the interconnection of the individual components which make up the system. The cardinal rule of good construction has always been to keep the leads as short as possible. This is a pretty loose rule and to the newly arrived VHF enthusiast, presents a perplexing problem when he begins to layout his new rig. The following graphs might be valuable in providing an insight into this problem as well as providing valuable design information for the construction of future equipment.



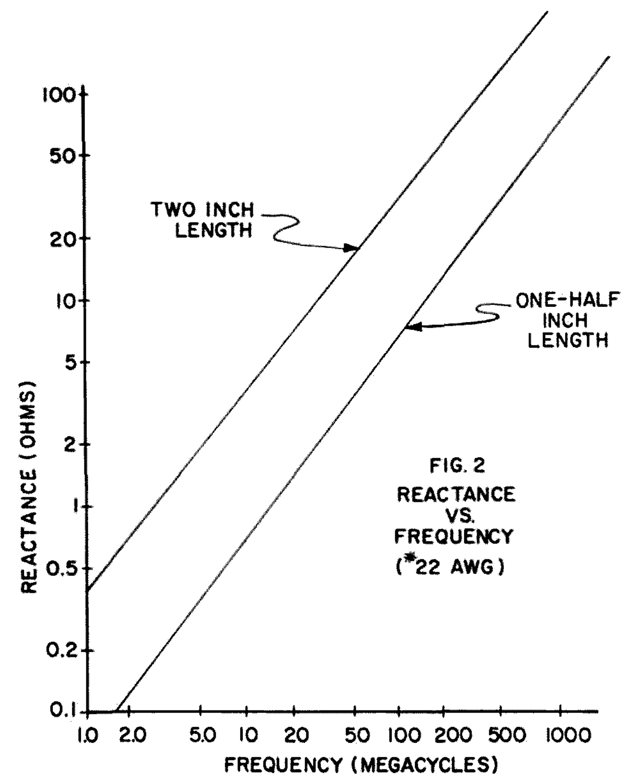
The inductance of a length of wire has been given as [1]

$$L = 0.005l[2.3\text{Log}_{10}\frac{16l\text{-}3d}{4d}]$$

where L = Inductance in microhenries
l = Length in inches
d = Diameter in inches

This is shown in Fig. 1 for various wire sizes from #28 AWG to #10 AWG. These sizes were selected as representative of the various sizes used in amateur gear today.

Fig. 2 demonstrates the size of the reactance which can be associated with a short length of wire. This is a graph of the reactance versus frequency for a one-half and a two inch length of #22 wire. Notice that at 140 megacycles the reactance is 10 ohms for the one-half inch length. However should the length be increased to two inches as it might be in order to reach from a plate cap of a 2E26 to a tuning capacitor on the front panel, the reactance would increase to 50 ohms. This increase in reactance could conceivably prevent the tank circuit from resonating or from loading properly in the two meter band, causing considerable head scratching on the part of the builder.



It is hoped that the illustration of one of the potential problem areas and a judicious use of the curves will aid in avoiding some of the pitfalls inherent in VHF construction. Always analyze the effect the additional inductance as determined from Fig. 1 would have on the critical path and modify the layout accordingly. And remember: in VHF, all paths are critical.

. . K5BLF

Reference

1. F. Langford-Smith, *Radiotron Designers Handbook*, p. 1287

Homer Gaston W5CZ

The Amateur and Civil Defense Emergencies

The next two or three years may be vital to the continued existence of Amateur Radio as we have known it. I have been a ham for fifty years and have never seen our ranks split as badly as they are now. Even during the Spark-C.W., C.W.-Phone, and AM-SSB family fights, we did not have the dissension we have had since the ARRL's incentive licensing proposal.

It is not my intention to discuss this proposal here except to say that regardless of its merits, and it has some, it was the worst handled matter to come out of ARRL in many years. The preliminary ground work was terrible.

Now let's talk about another controversial subject—Civil Defense and what you can do about it. Just because your local CD organization may not be too good (and have you taken the time to find out why it is or isn't good?) doesn't mean that in an emergency it will not determine whether people live or die. And before we get any further, quit thinking that CD will only function in a nuclear war. That may be true at the National, Regional and some State levels but your local and county CD organizations are vitally concerned with natural disasters such as floods, hurricanes, tornadoes, and so forth.

Civil Defense has been defined, somewhat inaccurately, as "Government in Emergency." Change that to "Governmental directed activities in an Emergency" and you will be much nearer the truth. Many volunteers not normally in government, except as taxpayers and voters, will be required in almost all large disasters and many small isolated incidents.

Now we come to something that conerns us all as radio amateurs.

In any emergency, the need for governmental communications becomes paramount. Not only are more circuits needed than in normal times but circuits are needed to locations which normally have little or no communications. The provision of these circuits whether wire, radio or by other means requires careful advanced planning. Even with the best planning cases usually arise where more emergency links are needed than anticipated.

RACES (Radio Amateur Civil Emergency Service) was established by the U. S. Government some years ago to provide the government at all levels, local, State and National, with an amateur radio back-up facility in emergencies. It is probably most comparable with the MARS facility which furnishes emergency and other communications for the various Armed Forces. One important difference is that while MARS is assigned frequencies outside the amateur band, the RACES frequencies are all within the amateur band; there is some hope that this condition may be corrected and that some frequencies outside the amateur bands will be assigned to RACES.

Perhaps a better understanding of the RACES organization would be a comparison between it and the other amateur emergency organizations.

The AREC is an organization of radio amateurs sponsored by ARRL and dedicated to public service in emergencies by furnishing communications to or from a disaster area. It is not responsible to any public or governmental body except as it sees fit to acknowledge in the emergency. The greater part of its traffic consists of third party messages of the "Tell Aunt Mary that Cousin Lucy is OK" type. This is not meant to downgrade this type of traffic. It probably has done more to improve the "ham image" than anything else. What I am trying to express is the idea that AREC, in itself, is a private organization handling personal traffic in emergencies unless specific arrangements are made to handle some governmental messages.

MARS is an organization of radio amateurs sponsored by a military department. It is strictly responsible to the military and generally handles traffic of a military or military connected type. Rigid discipline is necessary and is generally enforced.

RACES is an organization of radio amateurs sponsored by the Office of Civil Defense

within the Department of Defense. Its various levels are responsible to some level of government, local, State or National, and its members generally report to a Civil Defense Director at one of these levels. Traffic handled consists primarily of civil government messages although third party traffic of a more personal nature may be handled with permission if conditions permit.

From the above, perhaps over-simplified statements, you can see that the big difference in the three organizations is in the top control. Two are in semi-official capacities although manned by volunteers. All the MARS units have a mission of support to CD if it does not interfere with their primary mission. Many, if not most, MARS members belong to RACES and vice-versa.

The other big difference is that in a war condition only RACES frequencies would be available in the amateur bands. AREC operation would be cancelled, together with other strictly amateur operations.

Liaison and cooperation between AREC and RACES has been spotty. I believe this has been caused by the very luke-warm support of RACES by the ARRL Headquarters Staff. An example of this may be seen in past issues of QST in reports on AREC and RACES activities. AREC usually gets a page or so, frequently describing CD activities but reported under AREC news. RACES is lucky if it gets a paragraph. Reporting procedures are just not geared up to produce any different result at this time.

There are outstanding exceptions to the above. The Florida gang has the best disaster organization that I know about and there most of the hams involved belong to both organizations and function as one unit in disasters from the State level down to the local units.

There is very definite need for closer cooperation and coordination between these two organizations in most places. With more emphasis being devoted to improving the public image of the amateur, this appears to be one of the quickest ways to do it. At least it will help combat the image of the ham as "that fellow down the street who is always interfering with my TV."

Another point is this—if you don't want the CB boys to replace the hams in public service activities, it is up to you to do your part.

A prominent Civil Defense Director has written me as follows: (italics mine)

"I feel that I am most fortunate in the use of Citizen Band operators. As a ham of almost 40 years standing, I was most hesitant to use them but *after meeting almost no response*

from the local amateurs on tornado spotting, I brought the CB people in our county plan. They have been extremely cooperative, have developed their own maps of the county with their own grid system and have personally taken field strength measurements from all of the prominent higher altitudes throughout the county. They have also been very successful in having cooperation from those CB'ers not affiliated with us in remaining off Channel 20 when we are in a severe weather condition.

"I must stress the importance of RACES. This is a most opportune time to either augment or implement RACES operation by all Civil Defense Directors due to the emphasis being placed on PICAN because of the upcoming international radio-telegraph conference.

"I personally had a minimum response three years ago, I now have 48 RACES personnel operating on all three bands.

"In the less populated counties (ham wise) directors are still meeting *poor response from the local hams*."

I quote this letter because the remarks are typical of those I have heard from other CD Directors in all sections of the country.

With the above background remarks out of the way, let's get down to cases. What can you do and how do you go about getting started?

First, see your local CD Director and volunteer your services for communications. If you don't know who he is, ask your Mayor or the head of your county governing body for his name and office address. Nearly all counties and cities of any size have CD Directors. Some are very active, some are not. The odds are that you will be greeted with open arms and welcomed as a desirable volunteer.

The Director or his communications man will explain where you could fit into *his* organization and tell you about his communications plan. Suggestions are usually welcomed but be sure you know enough about the problem to give intelligent advice before starting a reorganization plan of your own!!

What types are needed by CD? Any licensed amateur can be of help. Some locations cannot use hams under 18 years of age because of insurance or other reasons. I have never heard of a top age limit. Mature people, preferably holding higher grade licenses and having experience in net operations, are of course most valuable.

What types of emission are used? Generally 6 and 2 meter AM and/or FM are presently used for local operation. Some 10, 40 and 80 meter operation is used for longer ranges. AM and SSB, CW and RTTY are in use on these frequencies in various areas. Incidentally AFSK Teletype is beginning to be used on the higher frequencies for point to point work in many areas.

Are you legally obligated when you are accepted in CD? No, you are a volunteer only. You will not be paid, although you may borrow equipment from some of the more affluent areas for temporary use away from the Emergency Operating Center. This practice varies. You may quit when you desire but if you are the type who wants to "pick up his marbles and go home" when things don't go right, don't volunteer. CD needs people who can be counted on when the chips are down and who can submit to a reasonable amount of discipline.

Civil Defense is probably one of the least understood branches of our government. It is generally operated with a minimum staff and in most of its emergency operations will rely heavily on regular governmental departments such as fire, police, etc. Even these departments would in turn rely on trained volunteers to augment their forces in large disasters.

The weakest link in the average Civil Defense organization is in communications. This is normally a commercial function in this country and is handled by telephone and radio companies who are not usually under the control of any local government bodies. Few people in government have any knowledge of what constitutes emergency communications. And without communications there is no control, only chaos.

To paraphrase a famous remark—Don't ask what Civil Defense can do for you until after you have answered the question "What can you do for Civil Defense?".

Do some investigating, then help Civil Defense, help Amateur Radio and help yourself.

. . . W5CZ

Wagner G3BID

Brussels International Mobile Rally

On the 22nd of September the International Mobile Rally organised by the Belgian Amateur Radio Society "U.B.A." in close co-operation with the Belgian Red Cross took place in and around Brussels.

This was in many ways a remarkable event. Firstly, it was a truly international event in which Mobile Radio Amateurs from Belgium, Holland, France, Germany and Britain took part. This was made possible by the generosity of the Belgian Authorities who were again willing to grant temporary mobile licenses to visiting Radio Amateurs from any country, irrespective of whether that country granted "Reciprocity" or not. This is the second time the Belgian and Dutch Governments have made this very generous gesture of International Goodwill (the first being for the Verviers Rally in April, 1963).

The Winner: ON4SN/M and SWL

Secondly, it should be noted that here were amateurs of several nationalities driving about a foreign country, on a crowded fine Sunday afternoon, operating their radios, map reading, following complex instructions in a strange country, and not a single accident has been reported nor a single infringement of either traffic or Radio regulations.

For these reasons alone the Rally would have been noteworthy.

But that is only an introduction.

The Rally itself, organised by U.B.A. whose President, Mr. Rene Vanmuysen, was responsible for the whole intricate organisation, began at a car park in the grounds of the 1958 Exhibition with ample parking space. Here each competing vehicle was issued with a carrier bag containing three envelopes. One to be opened at once, and the other two were S.O.S. envelopes to enable any competitor who failed to carry out all the instructions, to reach the ultimate rendezvous. These were issued in *four languages*—French, Dutch, German and English according to the nationality of the competitor.

The first instruction was merely to listen to the official U.B.A. Station, ON4UB, broadcast from 13.45 to 14.00 on 3.6 mc or 144 mc.

This broadcast instructed competitors in *four languages* to report to the parking place outside the church at Tervuren. This involved some map reading across Brussels.

At Tervuren a new envelope was issued instructing stations to call ON4VY for a code number. Thereafter they had to make five contacts with other Mobiles in the Rally and exchange the code number which each had received individually by radio before reporting to the church at Waterloo.

Here another set of instructions included calling the control station at Waterloo and exchanging a code number with the vehicle's own milometer reading.

At Waterloo the occasion was taken to ask a number of questions to answer which involved a complete sightseeing tour of the historic items connected with the Battle of Waterloo.

It will now be realised that the Radio Rally was deliberately devised to take competitors through some of the most beautiful country around Brussels, including the Foret de Soigne, as well as visiting historic sites like the Battlefield of Waterloo. Furthermore, the questionnaires issued at the various control points asked questions which involved a far more detailed sightseeing tour than a tourist would otherwise have undertaken, including visits to the Victor Hugo monument, the Prussian memorial, etc.

Here at Waterloo the check point was at the famous farm the "Belle Alliance" where Wellington and Blucher met after the battle.

At each check point a new set of instructions awaited the competitor always beautifully duplicated in his own language.

Instructions included calling certain check points at certain places and exchanging num-

ɔers, and exchanging these code numbers with ɔther mobile stations during radio contacts as vell as visiting many interesting places.

At the last check point a map was issued vith instructions to return to Brussels and endezvous at the Red Cross Headquarters.

Throughout the Rally the close co-operation ɔetween the Belgian Radio Club (U.B.A.) and he Belgian Red Cross was remarkable. The heck points were manned by Red Cross peronnel with Red Cross Mobile Stations. Red Cross personnel assisted with the parking and o difficulties were experienced in this respect t all.

Unknown to the competitors an emergency adio network was maintained with the Headuarters of the Red Cross in Brussels throughut the Rally on 157 mc FM. Had any accient taken place first aid could have been ummoned immediately through this emerency radio network.

When we returned and rallied at the Red Cross Headquarters the cooperation between ıe two organisations was remarkable. Here ıe Red Cross provided the car park, the uilding and the hall for the prize giving.

U.B.A., the Red Cross and other Belgians ad generously provided such a large number of prizes that the prize giving was quite a protracted affair.

Lastly, the Red Cross provided dinner for all the competitors and their passengers.

It is difficult adequately to express one's admiration for the work which Rene Vanmuysen, the U.B.A. and the Red Cross put into this remarkable venture, in which all instructions throughout were given in four languages, hundreds of envelopes prepared and so arranged to ensure that each competitor received his instructions in his own language.

As before, the end of the Rally was not the end of the fun. Our licenses had been granted to us for 14 days, both in Holland and Belgium, and there was still much operating and enjoyment to be had.

I, myself, had the pleasure of experimenting with an extension rod on the base of my Webster Bandspanner, suggested by W4TWW which improved my mobile reports very considerably.

Among the many stations worked from the mobile rig were—PY, LU, W, ZS6, CN8, 4X4, 5BX, ZB1, and such nearer rarities as—F9RY/FC.

The local contacts were also of major interest. After working a spot of DX near

Questionnaire

Please tear out this half page and send it in or put the answers on a separate letter or card. Just mark the appropriate letter(s) which answer each question.

1. Class of license I hold: Extra A; Advanced B; General C; Conditional D; Technician E; Novice F; none G.
2. My age: Under 20 A; 20-29 B; 30-39 C; 40-49 D; 50 up E.
3. Approximate investment I have in amateur radio equipment: Under $100 A; $100-$500 B; $500-$1000 C; $1000-$2000 D; $2000-$3000 E; $3000-$5000 F; Over $5000 G.
4. Number of years licensed: 0-1 A; 1-2 B; 2-3 C; 3-4 D; 4-5 E; 5-10 F; 10-15 G; 15-20 H; 20-30 J; over 30 K.
5. Modes I use: SSB A; AM B; CW C; RTTY D; NBFM E; WBFM F; TV G; Mobile H.
6. Bands I use fairly regularly (say once a week): 160M A; 80-75M B; 40M C; 20M D; 15M E; 10M F; 6M G; 2M H; 220 J; 432 K; 1296 L.
7. My main interests in amateur radio are: Rag chewing A; DX'ing B; QSL-Certificate hunting C; traffic D; CD nets & RACES E; building F; experimenting G; other H.
8. I read QST never A; sometimes B; regularly C.
9. I read CQ never A; sometimes B; regularly C.
10. I read 73 sometimes A; regularly B; devotedly C.
11. During the last year I have spent on mail order ham or surplus radio equipment 0-$9 A; $10-$24 B; $25-$50 C; $50-$99 D; over $100 E.
12. The Institute of Amateur Radio: I have joined A; I'm planning to join B; would join if it was less expensive C; don't care to join D; it should drop dead E.
13. My feelings about ham radio (select the closest): I'm all for it and am willing to devote a good deal of my time to helping it A; I'm all for it, but it is not important enough to spend much of my time on it B; great hobby, but let's face it, there are a lot more important things C; I'm supporting ARRL, let them worry about ham radio D; ham radio is just one of many hobbies, don't worry so much about it E.
14. The following purchases are contemplated soon: SSB transceiver A; receiver B; tower C; beam D; VHF gear E; test equipment F; transmitter G.
15. Mobile: none at present A; SSB transceiver B; 6M C; 2M D; AM E; WBFM F; near future G.
16. Club work: I belong to a local radio club A; I do not B.
17. During the next year I will probably spend on amateur radio equipment: under $100 A; $100-$200 B; $200-$300 C; $300-$500 D; $500-$750 E; $750-$1000 F; over $1000 G.
18. I have on hand catalogs from Allied A; Lafayette B; Heath C; Newark D; WRL E; B-A F; Harrison G; Radio Shack H.
19. 73 should have monthly columns on DX A; VHF-UHF B; RTTY C; YL D; propagation E; contests F; space G; transistors H; sideband J; clinic K; cryptogram L; TV M.

Waterloo from a place with the attractive name of Braine l'Alleud, we were called by ON4PZ who talked us into his home in Brussels, where we met his family and charming Vietnamese wife, as well as ON4AQ who runs a gymnasium, judo saloon and fencing institute and other physical culture activities in Brussels.

On another occasion we were called by ON4NJ who was located in a village called Wieze. This was some considerable distance from where we were at the time and we regretfully informed him we would not be able to call. Finding our batteries needed a bit of extra charging we cruised through the countryside without a particular destination and, to our great surprise, saw a signpost—"5-kilometres WIEZE." So, of course, we decided to call on our friend, ON4NJ, but we had forgotten to note his exact address and we did not think we would get there. However, a blind call on the frequency we had previously operated on the 15-meter band produced an almost immediate reply, and with great complication resulting from the one-way streets which had only just been organised because of the Autumn Festival (called "October Festival" though it takes place in September) we reached his house where we were made very welcome.

And so, when operating in a foreign country, one has all the pleasures of meeting the local radio amateurs in their homes in a way which would not otherwise be possible.

One must also remember that without the co-operation of the Belgian Government in granting licenses to all Radio Amateurs the whole event could not have taken place.

It should also be mentioned that the Netherlands Government were good enough to grant temporary mobile licenses to all amateurs passing through Holland to or from the Rally.

. . . G3BID

Charles Leedham, WA2TDH
101 W. 23rd Street
New York, N. Y.

The Callbook Game

It came to me the other night, after tuning around six and listening to a number of types trying valiantly to fit clever phonetics to their calls—and usually coming up with remarkably unmemorable duds—that one of the small but significant pleasures in this world is having a call which can be happily set to words. Something you can put a snappy phrase to, like what's-his-name does with Never Say Die for NSD, especially suitable because it fits his contentious nature so well. Or even Tall, Dark and Handsome, which may or may not be true, but is at least safe enough for me to use until ham television gets big.

Wouldn't it be nice, now, to have a call you didn't even have to think up phonetics for? Something ready-made like RAF, GMT, RFD, HCL (fora chemist), GOP, or BEM (this one may mean nothing to you, but a science-fiction fan would flip for it). Or even better, how about a word? Something nice and electronic like AMP or OHM, or maybe a name like JOE or BOB, or even something like EGG. All of which led me to what I call The Callbook Game, leafing through that massive reference work to see if all those possibilities actually were calls, or whether the FCC had eliminated anything that could possibly have a meaning. I found 'em all, but while looking up one, my eye lit on another, and the hideous thought struck me—fine, fine, but what about the other possibilities, the letters that added up to something not so nice and innocuous as RAF or EGG. Like RAT, which I happened upon, and, looking further, ROT. Did the FCC let the bad ones through, too? And if they draw the line anywhere, then where?

I kept looking, and leafing, and found that the good old FCC has hardly drawn the line at all. Think of a wild combination, and there is is in somebody's call—BAM, POW, URP, UGH and ECH for the comic-strip fans. How'd you like to come on the air and say, "This is URP?" Or announce yourself with a call ending in APE, BUM, CAD, ELF, GYP, HOG or SAP? Or how'd you like to be a female operator and announce yourself as PIG? That one exists, by the way.

One coincidence led me to look for others. I'd found that nobody is an XYL because there are no calls beginning with X, which was something of a surprise. Neither does anybody have a Q-signal, incidentally, because the FCC hasn't let any calls through beginning with QS or QR—and these were the first deliberate omissions I found. But how about TEX; could anybody with that call be lucky enough to live in Texas? Nope, the only one in the 5-area lives in Oklahoma. But what about names? In all the eye-blearing looking I could stand when that idea hit me, I found no JOE named Joseph, no JIM named James, no BOB named Robert, no TOM named Thomas, no RAY named Raymond, no ART named Arthur, or anything. There was one very, very near miss—one DOO is named Donald, and how he must have cursed the luck of the draw when he got his ticket. Or was it luck? The coincidence of getting just the next call to a real wow seems too close to be true, but I couldn't help wondering if some killjoy down at the FCC doesn't watch out for such things, and pushed poor Donald's call back one space in the file when he saw it would have been DON.

All is not milk and honey with getting a meaningful call, I discovered as I sat thinking up peculiar three-letter combinations and paging through the call-areas to find them. There's SEX, SIN, SLY and so help me, PUS. And for initials there are KKK, TVI, FBI, and, so help me again, FCC. How'd you like to come on the air with that one?

After considerable thinking, and considerable more looking, I found that the boys in Washington seem to have drawn the line at a very few combinations, including such an innocent

but understandable one as SOS, and a few of the more blatant obscenities which I can't even list here without getting the whole shebang banned from the mails. No doubt your own fertile imagination will come up with one or two that you won't find listed in the book. But the one's they've let through! Just think of any three-letter racial reference, for example, or even the best-known slurs, and you'll find them in somebody's call.

All of which led me to an interesting speculation. Namely, did the FCC even eliminate the worst of them, or did the unfortunate guy who got such a call just drop the idea of operating and never bother to renew the license because he couldn't bring himself to go on the air and announce himself with such a call. And what about some of the real doozers that are listed? I've never heard such a call on the air. It may be no more than statistical happenstance that I've never heard them, but I wonder if they, too, have dropped out.

Some calls, of course, are funny or obscene for no reason the FCC would possibly be expected to know, and wouldn't cause any problem in this country, but might get a little in the way of DX work. Anyone, for example, with the call ANO may have been having a little trouble making South American contacts and not knowing why—it's a vulgar word in Spanish, meaning exactly the same as another three-letter call beginning with "A" that the FCC has either eliminated from the list, or let through and then never heard from again in the way of renewals. And anybody with call PUD is going to get a lot of snickers when he tries to get through to England, for reasons I'd definitely better not go into. And whatever the terminal letters, a whole generation of WC2's—we're already half way through the alphabet on WB2's, if you haven't worked the "2" area lately—may have a bit of a problem in England, considering that W.C. is a standard abbreviation there for Water Closet, or john, or head, or whatever you may call it.

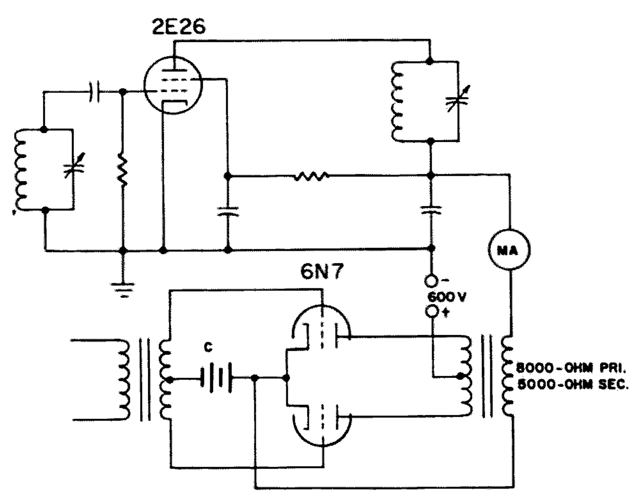
PUP, DOG, CAT, COW, ELK, HOG—the whole barnyard and pet world is there, and many, many more I haven't thought to look up yet. Have a look in the Callbook yourself. It's good entertainment on a dull evening when the band's dead and there's nothing better to do. I guarantee you'll find some dillies. Me, I'm waiting until a few more sunspot cycles have gone by and they've run all the way through WZ2ZZZ and start issuing the four-letter calls. Then I'm going to have some really fascinating reading!

. . . WA2TDH

Carl Drumeller W5EHC
5824 N. W. 58th St.
Oklahoma City 22, Okla.

Plate Modulation with Controlled Carrier

Many amateur-type transmitters are marketed or home constructed for controlled-carrier modulation. All of these, however, seem to be of the "efficiency modulation" nature. That is, they achieve modulation by varying the efficiency of the transmitter to convert dc power into rf power. The fact that power-contributing or plate modulation can be combined with control of carrier seems to have been forgotten. Really, though, this form of controlled-carrier modulation is the oldest; it was described in the amateur literature some thirty years ago.



ADJUST C FOR APPROXIMATELY 15 MA RESTING CURRENT

FIG. 1

There is a real advantage in using "power modulation". The af power contributed by the modulator adds to the dc power from the power supply, thus producing additional strength of the information-carrying sidebands. Control of the carrier has two significant advantages. One is the reduction of heterodynes, the other is the illusionary increase in signal strength produced by the AGC action in a receiver. These two attributes have made controlled-carrier operation popular, despite the universal acknowledgment of the superiority of plate modulation.

In all systems involving the control of carrier strength, the main problem is devising a method of increasing the carrier power exactly as the audio voltage is increased, timewise and magnitudewise. Many schemes have been dreamed up; most of them miss the ideal by a considerable margin, as is amply illustrated by listening to such transmitters on the amateur bands.

The method to be described, as has been said, is not new. It does, however, present a means of increasing carrierpower automatically and in exact synchronism with an increase in af power. No time lag is involved in either the increase or the decrease of carrier magnitude.

As with everything, one does not get the desired end without paying a price. The price, in this case, lies in a requirement for a higher voltage power supply than one would use with a constant-carrier system. Another price is the limitation of its application to only transmitters using "Class B" modulators.

Let's see how it works. Suppose you're going to build a little radiotelephone transmitter using a 2E26 in the final, modulated by a 6N7. This would run around 15 to 20 watts input. In the usual case, you'd power this combination with a power supply delivering 300 or 350 volts. For this application, however, you'll need a power supply delivering 600 to 700 volts, for you're going to place your modulator in series with the 2E26's dc plate voltage lead! Please note that this is not a re-hash of the ancient system of plate modulation by audio-frequency variation of a resistive element in series with the plate dc supply. There's a difference! In this case, modulation is effected by the audio power from the 6N7 "Class B" modulator. The series connection, dc-wise, is there solely to effect control of the carrier strength.

Let's take a moment out to consider what we'll be doing. If you've operated a transmitter using "Class B" modulation you've no

doubt noticed that the modulator's resting current is quite low. When you speak into the microphone, the current increases, varying with speech level. Because of the inertia of the meter, the current variations seem to "float" . . . to vary in a smoothed-out relationship with speech peaks. A bit of reflection, however, will show you that these variations actually follow speech levels precisely . . . no lag, no overshoot. Ah, now the idea develops! Why not let this current variation control the dc current of the modulated "Class C" stage? It is well known that the current in a series circuit is the same at all points. By placing the modulator in series with the "Class C" stage's power supply, we cause the "Class C" stage's resting current to be quite small. In fact, if we were to add a bit of C bias to the 6N7's grid, we could cut its (and the 2E26's) resting current to zero! There are sound reasons, though, why we don't want to overdo a good thing; we'll let a small resting current flow. But when we speak into the microphone, the 6N7's and the 2E26's plate current increases in exact synchronism. No over-modulation on even the first few cycles of voice-frequency audio, no hangover of strong carrier as the voice drops off!

Let your eyes roam over to Fig. 1, which depicts the circuit for a 6N7-2E26 combination. You'll see it's a very conventional circuit, differing only in the series (dc-wise) connection of modulator and modulated stages. The same circuit can be used for almost any final and modulator.

If you want the advantages of plate (power) modulation and the feeling of having done your part in reducing the number of useless heterodynes that infest amateur radiotelephone bands, build a transmitter incorporating this time-tested feature.

. . . W5EHC

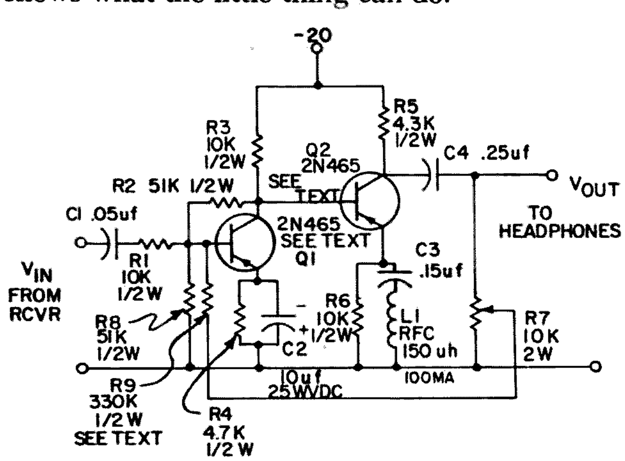
Clubs

It would be more than prudent to have your club secretary write to 73 for our special Club Plan. This unusual offer combines a special low introductory subscription price to 73, cash for the club treasury and free books for the club library or to be given away as door prizes at meetings.

A. G. Hansen
720 S. Harvey Ave.
Oak Park, Ill.

Audio Bandpass Filter

Some electronics companies are now advertising that they use digital computers to design their filter networks. For the ham who needs a very selective audio bandpass filter, but does not possess an IBM 650 and can't afford ten bucks for a high quality audio inductor, the following equipment is described. It is a two-stage transistor audio amplifier with a series resonant LC circuit in the forward loop, and uses positive feedback to increase the Q of the cheap and dirty tank circuit to as high a degree as might be desired. Its input is plugged into the headphone jack of the shack receiver, and the op's phones plug into the amplifier output. At a bandwidth of 80 cycles it has a peak gain of 20 db, and for slow CW signals (and there are some on the novice bands) the bandwidth can be decreased to the limit of intelligibility. Just for fun, the author increased the feedback to just short of instability, and measured a 3db bindwidth of 3.5 cycles at a center frequency of 1070 cycles. Made the signal sound like someone "strummin' on the ol' banjo", but it just shows what the little thing can do.



The schematic shows the design to be fairly conventional, as far as the two amplifier stages are concerned. The power supply is a 22½ volt battery, current drain being only 2½ mils. The first stage is rather stiffly biased, and uses negative voltage feedback from the collector to the base. This serves to improve gain stability, and also to reduce the output impedance of the amplifier, thus improving the power transfer to the succeeding stage, which near resonance has a low impedance input. The emitter resistor of the first stage is heavily bypassed, which tends to make this stage have a low input impedance. Coupling from the input is through a capacitor and series 10K resistor, which simulates pretty well a head phone load on the communications receiver.

The base of the second stage is tied directly to the collector of the first, thus simplifying bias and coupling. Note that the emitter resistor of this stage is paralleled by a series capacitor and inductor (150 millihenry rf choke). At frequencies far removed from resonance of the LC combination, the emitter impedance of the second stage is essentially the emitter resistor, but near resonance the impedance of the series LC begins to drop. Thus, near resonance, the low series impedance of the tank predominates and the flow of base current is increased, assisted by the low output impedance of the first stage.

It will be noted that two 180 degree phase reversals take place in the amplifier, one in each stage. Thus, the output voltage, taken from the collector of the second stage, is in phase with the input voltage, and the feedback from the pot through the fixed resistor is regenerative. In essence, this means that as more signal gets through the amplifier, more is fed back, and since the gain of the amplifier increases near resonance, due to the series LC circuit, the output voltage rises sharply near resonance. This is what transforms a low-Q circuit into a highly selective audio amplifier.

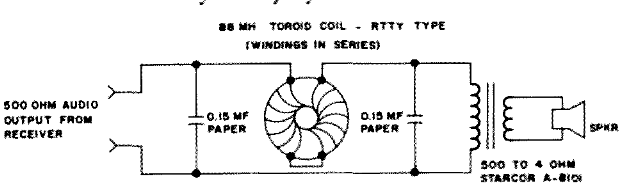
Construction is straightforward. Parts layout is not in the least critical, and considerale latitude is allowed in the transistors. In fact, almost any low power audio transistor can be used. The only component which requires care is the fixed feedback resistor. Values should be tried until one is found which just produces oscillation when the pot is fully advanced to the maximum feedback position. Thus, when you're ready to operate, plug the amplifier into the phone jack of the receiver, the headphones into the amplifier output jack, and advance the regeneration control until a whistle is heard. Back off a bit, and you're in business. . . . Hansen

SSB Audio Filter

Have you ever noticed the amount of high frequency "garbage" or "monkey chatter" that seems to show up when you use a loudspeaker when listening to SSB signals? High frequency, adjacent-channel buckshot and howls tend to make life miserable, and will drive the operator back to headphones having a restricted audio response in many cases.

This annoying high frequency response occurs in even the best of receivers and is often due to unwanted components that "sneak around" the selectivity determining circuits of the receiver. Rejection of your receiver to unwanted energy six or seven kilocycles away from the passband might be of the order of fifty or sixty decibels; but when a strong signal many, many decibels above S-9 is adjacent to your listening channel, some energy cannot help but "leak around" the passband unless your receiver has an unusual (and expensive) *if* rejection system.

You can help solve this problem in two ways: The expensive way is to rebuild or otherwise modify your receiver to reject signals in the adjacent channels, or you can make up a low-pass audio filter that will prevent the adjacent channel "garbage" from reaching your ears. This second solution will cost you about a dollar. It will not reject interference in your communication channel, but it certainly assists in killing QRM that often "leaks around" your *if* system.



Shown in the illustration is a simple audio filter designed to cutoff at about 2500 cycles. It should be placed in the 500 ohm audio line between the receiver and the speaker. The inductor is a 88 millihenry toroid coil, beloved by the RTTY gang, and availabl from many sources. The two windings of the coil are placed in series and the coil may be mounted to the inside wall of the speaker cabinet. If the cabinet is metal, space the coil away from the wall about ½-inch by means of a long 6-32 brass bolt and two rubber washers.

It will take you about five minutes to make up this simple filter. Used with a Collins 75A-4, it makes an impressive reduction in the amount of high frequency "monkey chatter" in speaker reception, and makes sideband reception on the speaker a pleasure instead of a chore.

. . . W6SAI

Correcting the Errors in the Errorless RTTY Converter

Jim Kyle K5JKX
1236 N. E. 44th
Oklahoma City, Okla.

Since publication of my "Errorless RTTY Converter" (page 12 September 1963 issue of 73) I have been deluged with letters from the RTTY gang. Some have come from as far as VK land. It's encouraging that so many people are interested in the thump-and-bump techniques of communication—even though 99.9 per cent of the letters asked the same question: "I've built it now how can I make it work?"

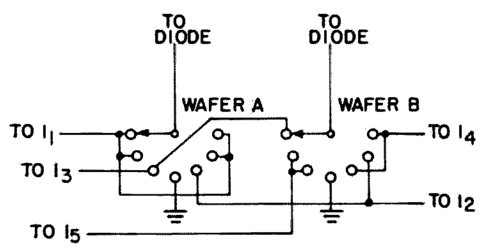


FIG. 1 CORRECT SWITCH WIRING

If ever a project were misnamed the "Errorless" is that project. For a while it appeared that the whole thing was one major error on all our parts. But when the basic trouble was tracked down it turned out to be simple (though highly improbable). The question now is "How did that one fellow get his to play?"

The original Errorless was more or less pitched together out of the junkbox and it seemed to be so uncriticial that the normal "tolerance tests" (switching tubes around, etc.) weren't made on it. Never again. I haven't calculated the odds against this happening again, but two of the three 12AX7's used in that model were slightly defective. If they hadn't been, it would never have played. So naturally, when all the rest of the gang built them up with good tubes, came trouble.

Just to complicate matters, the schematic itself with the original article contained three errors. Any one of them would bollix things up in a large way. Before we get into the major problem, its cause, and its cure, let's get these little things out of the way.

The first error was omission of a 100K resistor from the "switch" side of I1 to ground. Without this resistor, I1 has no ground path and cannot ever light. This, in turn, locks the converter in the non-print condition on switch positions 1, 2, 6, and 7, for the "fictitious" signal required in these positions won't be present.

The second error was in the switch wiring. Since the original schematic included no reference designations for the switch wafers or terminals, a corrected switch schematic appears in Fig. 1. The error was a transposition of wires between terminals 5 and 6 of Wafer A. This error made bilateral copy of mark-high signals impossible, and left you copying from space signals only on positions 5, 6, and 7. Since 5 and 7 were already dead because of the omitted resistor this meant that the only switch positions which would allow operation were 3 and 6.

The third error was in the value of the resistor from V5's grid to ground. Instead of 56K, it should have been 22K. As drawn, the output Schmitt wouldn't trigger. Adding a 47K from screen to cathode on V5 improves triggering reliability, and lets us discard the 100K 2-watt Zener "keep-alive" resistor also.

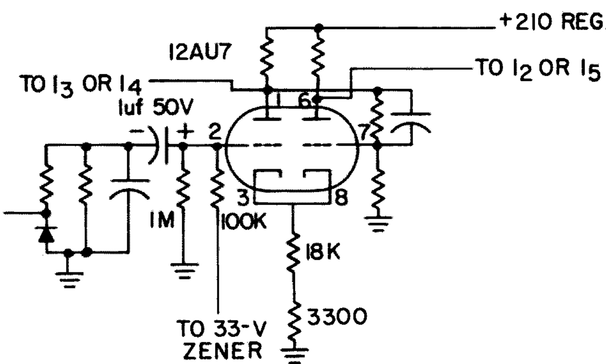


FIG. 2 CORRECTED CIRCUIT FOR V2 AND V3

With these three errors corrected, application of +30 volts across the neon-load resistors flips the output trigger and lets the printer magnet drop out. Any voltage less than +20 here holds the magnet in, with up to 75 ma current. Current can be reduced by making the screen voltage for V5 lower.

Now let's go into the big problem. The plain truth of the matter is that, as published, the V2 and V3 Schmitts won't flip. As I said, I don't know what the odds against its happening again are, but I imagine somewhat greater than those against drawing three cards to fill a royal flush, or being dealt a perfect bridge hand. But it appears that both my 12AX7's were slightly gassy, just enough to

get a semi-thyration action, letting them work in the circuit.

The first dozen or so who wrote about this were advised to add positive bias to the input grid, making it easier to trigger. My apologies go out to everyone who tried this quick and simple "cure" because that didn't work out either. Finding the real cure for the situation took quite a bit of breadboard experimentation. In the middle of it all, W9QAZ dropped in for the specific purpose of finding out how this thing was supposed to work, and he helped quite a bit in the later stages.

Between us, we came up with not just one but two cures. One uses most of the published circuit intact; the other requires that virtually every component value in the circuits of V2 and V3 be changed, but gives vastly increased switching sensitivity. You can take your choice.

The little-change cure requires that the dc connection from the detector output to the input grid be broken, and + 30 volts bias be applied to the grid. In addition, the 10K cathode resistor must be replaced with 21,300 ohms. To get this value, use an 18K and a 3300 in series. The resistance value was found to be critical within 100 ohms for positive switching and good sensitivity. 22K wouldn't switch, and 20K required an input signal of approximately 40 volts peak-to-peak.

With 21,300 ohms, and the 30-volt positive bias, a 4-volt peak-to-peak (about 1½ volts rms) signal from the detectors gave positive switching. Plate voltage was also found to be reasonably critical, and was regulated at + 210. Operation was still obtainable at voltages as low as + 175 or as high as + 225, but again sensitivity was lowered.

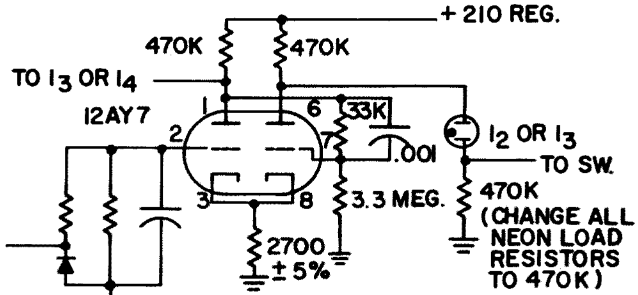
The final, and most important, circuit change for this approach was to replace the 12AX7 with a 12AU7. The 12AX7, when in good condition, was found to be unsuitable for this circuit!

The changes required for this approach are shown in Fig. 2. Values not indicated are unchanged from the original circuit.

After discovering that the 12AU7 worked much better than the 12AX7 in the hookup, I set out to test all the twin-triodes of this general type which I had available. The 12AT7 was found to be usable though not particularly good—but the 12AY7, a not so well known tube, came out almost perfect. It was employed in the high-sensitivity version.

The schematic for this circuit appears in Fig. 3. Note that the positive grid bias is no longer necessary when using the 12AY7 and the changed resistance values. The trigger remains "off" so long as input voltage is less than 100 millivolts, and switches "on" with positive action as input passes 300 millivolts. It returns to "off" when the voltage drops below 200 millivolts at the end of the mark or space tone.

To get this remarkable sensitivity, the plate supply once again was regulated at + 210 and the cathode resistor was found to be fairly critical at 2700 ohms. A standard 5 per cent resistor can be used, however, with no worries. Raising cathode resistance to 3300 ohms merely reduces sensitivity slightly, to 2½ volts.



TUBE	NEONS	
V2	I4	I5
V3	I3	I2

FIG. 3 HIGH-SENSITIVITY FOR V_2 AND V_3

A few of the gang have inquired about the filters used ahead of this unit. As mentioned before, almost anything can be used. The filters referred to in the original article were described in the November, 1962, issue of 73 by W3TUZ on page 32.

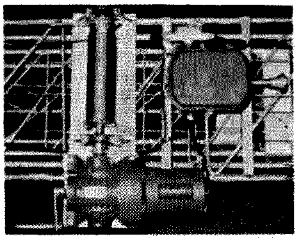
Most people want to know more about the 33-volt Zener. It should be rated for at least 10 watts. One such Zener, manufactured by many firms, is the 1N2990. Don't pay extra for an A or B suffix; these indicate tighter tolerances, rather than a newer model as they would in vacuum tubes. This unit sells for about $5 most places, but Lafayette Radio lists a Dickson Diodes 1N2990 in their 1964 catalog for less than $4.

Not mentioned in the original article, because I hadn't discovered it at that time, is the fact that power-supply voltage should not be allowed to exceed 300. The output trigger works nicely a 250 volts, and if you build up a supply for the unit 250 would be the best target to shoot for. When the voltage rises as high as 310, the output trigger locks up and won't drop out on space!

Despite the errors involved in the original article, the unit itself still qualifies for its "Errorless" name. If you can tell a signal is there, this gadget will give you the cleanest possible copy of it. So, as I said the first time, happy digital RTTY!

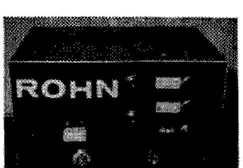
. . . K5JKX

New Products

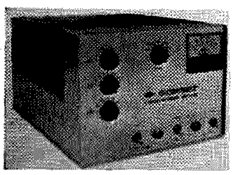


Rohn Automatic Winch

Rohn has announced a new motorized winch for its H.D. Series Crank Up Towers. The winch unit consists of the winch, a heavy-duty weather-proof motor and gearbox, and the Rohn Model 100 Tower Controller. The complete unit is wired at the factory and is supplied with 25 feet of two conductor power cables. Two connections to a 115 VAC 60 cps source are all that is required to ready the tower for operation. The Rohn Model 100 Tower Controller is contained in a cast aluminum weather-proof housing that is equipped with a lockable latch. The housing is also equipped with a screened vent to prevent moisture accumulation within the housing due to temperature changes. The control panel contains the control circuits switch which allows all power to be removed from the circuits for safety while working on or around the tower, fuse protection for the control circuits, indicator light for power and fuses, reset device for motor protection and momentary contact pushbuttons for controlling the up, down and stop functions of the tower. Limit switches are utilized to prevent damage to the tower through excessive up and down limits of travel. They are weatherproof and contained in cast housings to assure long life and reliable lock operation. Ready access is obtained to the Tower Controller by the removal of just four screws. The control panel may be moved aside for access to wiring and terminal strips.



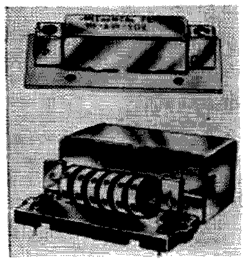
The Rohn Model 200 Remote Control Unit, an added optional feature, enables the operator to control the tower from a remote point with all the ease of local control with the added convenience of a tower height indicator. The remote control unit is equipped with a key-operated power switch, indicator light, momentary contact pushbuttons for controlling the up, down and stop functions of the tower, lights indicating direction of tower travel, height indicator and calibration switches to set indicator to read elevation of tower or antenna top above ground level. The motorized winch unit is supplied with a hand crank to allow the tower to be raised and lowered manually in case of power failure. Whether operated from the base of the tower or by remote control, the new Rohn Motorized winch adds new ease, convenience and accuracy to controlling tower height for the amateur and the experimenter, and is provided with all the assurances of quality workmanship, superior design and functional capabilities inherent in the Rohn line of towers and accessories. For complete information, contact the Rohn Manufacturing Company, P. O. Box 2000, Peoria, Illinois.



Gonset Finals

Gonset has 2 new VHF finals you ought to investigate. They are designed to operate as Class AB_1 linear amplifiers providing 200 watts output, or as non linear Class C units handling 280 watts output on 6 or 2 meters. Under Class AB_1 operation the units may be employed for SSB, AM, CW, MCW, FM and FSK service, and in Class C operation for FM, PM, and CW service. In addition, they both have frequency ranges (model 903A—144-148 mc, model 913A—50-54 mc), that extend well beyond the amateur bands, permitting the application MARS, and CAP, and other military frequency allocations. On special order, rf amplifiers to cover any segment of the frequency range from 1.6-500 mc are available.

The new Gonset RF Power Amplifiers are also equipped with all necessary supplies and are rated for continuous commercial and amateur service (CCAS). The high voltage supply incorporates a solid-state bridge rectifier composed of 24 800piv-750ma, controlled avalanche diodes for high reliability. The unit also employs a husky solid-state 400piv-500ma diode in the bias supply. Both amplifiers have been designed as ideal companion units for Gonset's 2-meter Sidewinder and the new Gonset 6-meter Sidewinder, or any of the Communicator series and any other exciter capable of producing at least 5 watts. Attenuator pads are available if needed. For more detailed information and specifications write to Gonset, 1515 S. Manchester Avenue, Anaheim, California.



Lafayette Mechanical Filter

Lafayette Radio Electronics Corporation has introduced a highly selective mechanical filter for use in amateur, cw and ssb communications receivers. With the influx of new stations and narrow bandwidths prevalent today it is necessary to increase the selectivity of present receivers with an intermediate frequency of 455kc. The Lafayette mechanical filter closely approximates an steep-skirted, flat-top ideal band pass response. At 2.5 kc on either side of the center frequency, the filter provides 60 db attentuation of unwanted signals assuring complete adjacent channel rejection. With the mechanical filter comes a network consisting of two coupling transformers mounted on a PC board only 2¾W × 5/8H × 1 3/8D. Price is $19.95. Full Specifications are available on request from Lafayette Radio Corporation, 111 Jericho Turnpike, Syosset, L.I., N.Y.

New Heathkit 6 & 2 Meter Converters

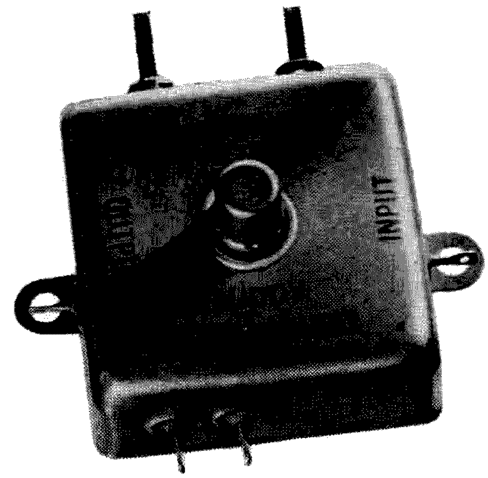
The Heath Company, Benton Harbor, Michigan, has announced the availability of two new 6 & 2 meter converters to extend the operation of the Heathkit Model SB-300 SSB Receiver for high performance VHF Reception. Both models can also be used with any receiver providing appropriate voltages and 10-meter coverage.

The 6-meter model, Kit SBA-300-3, extends coverage of the SB-300 Receiver from 48 to 54 mc (50 to 52 mc with crystal supplied), and the 2-meter converter, Kit SBA-300-4, extends coverage from 142 to 150 mc (144 to 146 mc using crystal supplied).

Both units are easily installed on the SB-300's rear cabinet panel with simple plug-in connections and power cables. One switch activates either converter.

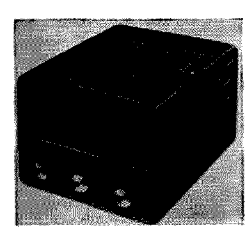
In addition, each converter uses a 6DJ8 cascode amplifier for low noise factor and high sensitivity and there's an applied AGC provision for strong signal handling capability.

Each converter sells for $19.95. For full information, write the Heath Company, Benton Harbor, Michigan 49023. A free 108-page catalog describing the converters, as well as over 250 Heathkit products will be sent your way.



Buddy VHF Preamp

Marina Products has come out with a new Nuvistor preamplifier for 6 and 2 meters. The Buddy preamp gives up to 20 db gain yet doesn't require neutralization. Frequency adjustment is very easy. It reduces spurious responses by adding 2 tuned circuits where they do the most good. It's very small (only 2 × 2 × ⅞ in.) so is easy to fit into almost any receiver or transceiver. There are only 4 connections to make: input, output, 6.3 vac and B+. Everything needed for the easy installation is included. We tried the 2 meter model on a converter using 2 g.g. 6CW4's and the improvement was very impressive. Best news of all is the price—$9.95 for 2m, $8.95 for 6m. A CB model is also available. Marina Products, 2912 Industrial Way, A Santa Maria, California.



Lafayette VFO

Lafayette Radio has introduced a new self-powered VFO covering the 80 through 10 meter amateur bands. The 99-2501 VFO uses a high "Q" series tuned Clapp oscillator with a VR tube to eliminate frequency shift due to line voltage fluctuation. There are two output impedances and output is sufficient to drive most modern transmitters. It features a large easy-to-read illuminated slide rule dial with a smooth tuning drive. The power supply uses silicon diodes and operates on 117 vac. tubes: 6AW6, 6AQ5, OA2. Dimensions: 6½W × 5¼H × 7½" D. More information is available from Lafayette at 111 Jericho Turnpike, Syosset, L. I., N. Y.

New Literature

Mobile Handbook

Sams' new book, the *Two Way Mobile Radio Handbook* by Jack Nelmi will interest anyone who works with mobile radio. The table of contents indicates the thorough coverage: Basic Systems, Receiver and Front End Circuits, IF Systems, Squelch and AFC, Transmitters, Control Systems, Antenna Systems, Power, Servicing, Setting up the Shop, Sales and Service, and Common Carrier Service. The book is written in Sams' usual clear style. Price $3.95 from your dealer or from Howard W. Sams, 4300 West 62nd Street, Indianapolis, Indiana.

Mobile Interference Book

Bothered by interference in your boat or car? Hallett Manufacturing Company has a new book available that describes the sources and elimination of interference to mobile rigs. In an easy to understand question and answer style, the book will help you discover what is causing interference and how you can use suppression kits, filters and shielded ignition systems to prevent it. This informative book was written by Robert McIntosh, the president of Hallett and is free to anyone using, selling or servicing mobile gear. Write to Hallet Manufacturing Company, 5910 Bowcroft Street, Los Angeles, Calif.

Writer's Handbook

Anyone who wants to write for 73 (or any other technical magazine) should read the *Technical Writer's and Editor's Stylebook* carefully. It will help to improve the clarity and grammar of your writing and will show you how to prepare manuscripts that will not give us fits. The well-known author, Rufus Turner K6AI, covers the basics of technical writing, manuscript preparation, grammatical construction (the way it should be taught in schools), punctuation, use of math, etc. Also included are a number of tables and glossaries that will prove very valuable to any writer. It's published by Howard W. Sams, 4300 West 62nd Street, Indianapolis, Indiana. Price: $3.95 softbound, $4.95 in hard covers.

Tri-Ex Catalog

Tri-Ex Towers has a new catalog out. It includes all of their fine products, such as ham and industrial crank-up and tilt-overtowers, motorized crank-up towers, rotating towers, guying accessories, communications towers, economy towers, tower trailers, brackets, standoffs, etc. Just about anything you could possibly imagine in towers and related gear is included. Write to Tri-Ex Towers, 127 East Inyo Street, Tulare, California and they'll be glad to send you one.

Letters

Good morning, Wayne,

Played at the Richmond Radio Club Friday night was a tape of a debate between John Huntoon and yourself at a convention of some sort somewhere in New England last Spring. This was sent to WA6UFW, who thought of the idea for a similar debate out here back with the Pacific Division Convention in September. Since Huntoon and other West coast prominents of the League refused to debate with such a scurvy character as yourself, Don bugged Huntoon about it at the Convention. Huntoon's excuse was that another debate would be useless, since it would probably turn out like the one in New England. He offered, instead, to send Don a tape of that debate.

Well, after listening to that two hour tape, I can see why Huntoon was not anxious to have it repeated! I am curious a to why he even sent it to us in the first place; it sure did not seem to represent a "victory" for the ARRL.

One more thing about the December 73, where can I get a wall clock like the one on page 56? Is it a half-sized clock for crowded walls, or does it go from 1 o'clock to 48 o'clock, for weekend contests?

Bob Suerstedt, WA6VAT
1867 Van Ness
San Pablo, Calif.

Dear Wayne:

It seems we amateurs are critized for not doing enough public service. However I believe a lot of hams hide their light under a bushel and I would like you know what the "Old Pueblo Radio Club" is doing in Tucson.

Phil Richardson K7OBS has been meeting the Eye Bank here for quite some time and will now be assisted by Skip, K7DHD and Tom, K7RME. The Eye Bank Net reports that by October 10, 1964, five hundred eyes were exchanged. Skip, K7DHD recently received some nice newspaper publicity for his work in the eyebank.

Phil, K7OBS was instrumental in getting our club a permanent meeting place from the city and we will also get a special room for radio equipment and as a shop for construction. As Phil also manages Radio Station KTKT we get extra publicity there. An SSB transceiver has been purchased. We are also incorporating to protect the officers and members. Ham-TV may be included.

Club projects are as follows. Code and Theory instruction. The newspapers gave us some publicity with the result that between 135 and 140 persons showed up for registration. And at the fourth session we had between 80 and ninety still attending classes.

Under Edil, K7ICK, leadership, John, K7JQJ is teaching advanced theory Chet, K7VYF and Tony, DL6UK is teaching code with the assistance of Dave, K7WMA, Mark K7OLZ and John, K7VZB, Huddy, W7QNC has worked hard and been at every session. He is our present president and K7OBS is vice. Pres.

The big project of the year is "Operation 52." This has been in effect for several years and is certainly a public service project. Each year the parents of each child at the Asthmatic Foundation here is contacted and effort made to have a ham in that city furnish a phone patch so that each child may talk to it's parent on or at Christmas time. This year it will be 26th and 27th of December. "Skip," K7HDH will be co-ordinator of Operation 52 this year.

Outside of this we have had some very good speakers at various meetings in the past and in September we had an ATV demonstration with two complete stations.

I feel that the above gives some of the other clubs something to shoot at. My own projects have been handling some traffic and drumming up interest in ATV and UHF.

Al Johnson, K7VQI

Dear Wayne,

One thing which you may know, but that some of your readers may not—the Army offers a eries of correspondence courses in electronics which are very thorough, free to members of the Army Reserve and I think to people in MARS also. These courses range from mathematics and use of the slide rule to SSB, transients and wave forms, pulse techniques and so on. From those courses I have taken, I can say that they are excellently presented, and that the questions and exercises at the end of each lesson really help the material to stick after you've read it. I have found that just buying books on electronic theory can be a sad experience. Either the book will quickly sail off into higher mathematics and leave me far behind, or else it will be full of little figure drawings of Vicky Volt and Andy Ampere on their merry electronic way. The Army courses offer a good compromise and can provide the sort of technical background that a ham can really use. Information on how to apply for these courses can be obtained by Reservists at their local reserve center. The reserve center will also have a catalog showing the courses available. They are offered both by the Signal Corps, and the Army Security Agency.

One other thing, hams of draft age shouldn't overlook the chance to learn something about their hobby while they serve their time. Being a radio operator or a repairman can be a much more enjoyable way to spend a few years than woofing around in the mud with a rifle. Not only the individual benefits from the training he receives, but the service benefits also from having a man who has prior experience and some interest in his work. Also the ingenuity for which hams are famous often leads them to solve problems which more dogmatic types can not handle.

Well, I guess that's about all. I envy you, living up there in New Hampshire. I have climbed Mt. Monadnock three or four times and have done some work for a person with a summer home near the bae of the toll road. There's an awful lot of nice real estate up there.

Alan Tompkins
New Haven, Conn.

Hi!

You sure built up 73 magazine since the first few years. Congratulations. The XYL and I visited you the day you got your horse . . . remember? I'm through with QST. Don't need it at all. They still have the old attitude, "Father Knows Best." I like your down to earth editorials. QST is too big for its breeches. An organization for the interest first of the QST brass, then the interest of the ham. Keep up the good work.

Fred Haas W2SF
Bronxville, N. Y.

Dear Wayne:

Congratulations to I.O.A.R. for the fine flaming decals designating the founding members. We certainly will use them with pride. Also we consider the publishing by I.O.A.R. of FCC Part 97 Rules and regulations for its members a great service. This is the first time we have had them available for reference in a suitable form that can be filed for quick reference should we desire and many questions come up most daily that need them for reference. I assume that the I.O.A.R. will also keep its members advised of changes when they become effective.

We are of the same opinion as you that the more readers of 73 we have the more interest will be taken in the preservation of our hobby. (Don't let ARRL hear me call it a hobby.) Huntoon broke down and wrote me a letter asking me to rejoin the ARRL. I shall consider it. However, that seems to be the only way that I could get a letter from them as they would not answer mine while I was a member, HI.

IOAR's organizational chart and the report on the funds were informative and of interest to me and I appreciate this personal attention. I certainly hope that IOAR never gets so large in scope that its members become numbers to denote power for your office to use, as has been the case in others, HI.

Ted Ames K1VHT
Millinocket, Maine

Dear Wayne,

Over the June 5-6th holidays there will be a very, very big German Ham Convention in Berlin held by DARC. The mayor of Berlin (and possibly the next Chancellor of Germany) Willy Brandt will be sponsoring the event. We will have about 2000 hams in our city. Delegations from England, Sweden and Switzerland have already announced their participation. There will be a grand opening at the largest studio hall of Radio Free Berlin, exhibitions of all kinds by manufacturers and stores on the fair ground at the Funkturm, meetings for different divisions of our hobby (DX, YL, VHF, etc.), hidden transmitter hunts, a BIG hamfest (two bands and variety program), a tour of both sides of the city and more.

A few words of comment on the war between the ARRL leaders and Green. Much of it is of little interest to German hams, e.g. incentive licensing, dictatorship, etc., but from what I hear, hams in DL do not generally think that the ARRL is exercising good leadership for the good of international hamdom. I think the ARRL could do much for the ham by working up a general prodecure to be used in all countries to influence the respective governments in our favor. Lobbying is badly needed on an international basis just for the sake of survival. This is a tough problem since, particularly in the newer countries, you don't have but a few hams and they have little or no influence on their governments. Commercial radio and communications services are the greatest threat to amateur radio and this situation should require every effort of all hams everywhere.

I don't want to go into details on the accomplishments of the ARRL during recent years or the recent proposals, etc. To a foreigner most of them are of no interest or even seem ridiculous. Has anyone thought of starting an international training program for hams? Sure, it would cost money, but it would be money well spent. Like for instance the Hudson Amateur Radio Council might sponsor a three year training program for hams in the newly independent Balumbumbia instead of wasting their time and dough on that K2US fiasco. Or the Florida boys might help hams in Iran set up an emergency net for communication after those earthquakes they have there.

Wayne, you take over from there. Maybe my ideas can give you and your "enemies" something to talk over. And maybe it would give CQ a chance to give the money they owe you to a good cause. I'm sure you wouldn't mind.

Pete DL7EU
Berlin, Germany

Dear Wayne,

I've been reading with interest, the controversy as regards the ham bands, FCC, ARRL, and the Geneva Conference coming up with the attendant possibility of reallocation of bands, stiffer tests, etc. I think hams should be limited to 50 watts, the lower frequency bands taken away entirely . . . Rather abrupt, too drastic, you say? Remember, "What have you done for me recently?"; this applies to hams today. What have they done for radio recently?

I'd like to sketch a little personal picture for you to elucidate the above. I'm a mechanical engineer who decided, because of automation, to study industrial electronics at night and pick up an asociate degree. When I finished, I decided to use this knowledge for personal a well as professional use. I took the Novice and Technician exams in 37 minutes—they're too easy. I bought a 15 watt transceiver to "get on the air with," bought a BC-645 to convert for 420 mc, an SCR 522 for 2 meter, started converting, built a beam, 6 meter and 2 meter converters; after a couple of months on the air, everything came to a "screeching halt."

I joined a club, "York Road Radio Club," and found the group more interested in parliamentary procedure and how to attract new members than winding coils or building equipment. The president actually bragged about a friend bringing a 675 watt 6 meter transmitter to his house every so often to, in his words, "Wipe out tv in my neighborhood." (He didn't like his neighbors). Obviously, I quit since I seemed to be a minority there. I joined AREC, and the first time I monitored our local frequency, I heard a couple of kids pettishly complaining about a commander usurping a coordinator's authority (or vice versa). I don't think the roll was even 30% complete during the 3 or 4 nets I monitored.

I joined MARS—there's a serious business—the members join to get equipment and if you talk about service and duty, you're laughed at. After I chalked up about 12 roll calls, I could see why: the extent of traffic was "Mom: I'll be home Saturday at 7:00," or some such equally important message.

When I got my license, I was full of enthusiasm for ham radio: now, after a year and a half, I've concluded that ham radio is overrun with "B.S. merchants" who have no interest in ham radio as a "service," nor in electronics technology. (The CBers did more in N. J. during a recent forest fire than hams.)

If this seems like a scathing attack on hams generally, I don't mean it to be, but dammit, it's certainly an indictment of the segment I've contacted so far.

I haven't even mentioned the slobs that go buy a 2000w PEP sideband rig and don't even know (or care) what's inside, the clowns who make contacts just to count QSL cards—who hardly stay with you long enough to find out if they can talk about ham gear intelligently, the lovable fellows who won't even answer you if you don't pin their S meter when you call or answer them, the idiots that really spout the "jargon" like professional radio announcers, but lose patience if you're interested in specific equipment info: these are the lesser lights.

Now, I'm not a child (36), not stupid, (I'm proficeint in two areas; "mechanical engineering" and "electronics"). I certainly have no personal reason to pick on hams, and these are my honest feelings. My recommendations to my congressman are: relegate hams to the UHF bands, open up more CB, lower max power, let >1 watt transmitters operate unlicensed in all ham bands, let the license level (with attendant test) determine max power, retest every 5 years with renewal.

In conclusion, if my experiences had been other than I've outlined, I'd still feel that hams can do just as much BSing at 1500 mc as at 14 mc, learn more by havnig to cope with the UHF wiring and propagation, and do a greater service to the general population (who are still the majority) in opening up these bands. Ham radio is a hobby, but since it utilizes publicly owned property, the radio bands, hams have a real responsibility to the people who have allowed them to use this property. Are they meeting this responsibility today as hams did in the past? I doubt it—

Robert R. Shue K3YEW
Willow Grove, Penna.

Yes Robert, many of us have run into the situations you describe. The solution to these problems really isn't to take operating privileges away from everyone as you, and the League, propose. Your quitting the radio club did more to weaken amateur radio than the irresponsible president for you, if you'd worked at the problem, could have gathered together the more thinking members and gradually gained enough influence to guide the club progressively. I've run across the same situation many times. Sure, sometimes it takes a year or two to get things straightened out, but you have reason and reasonable men on your side and you can't lose. The same thing goes for the AREC and MARS. While a few of these nets are toys in the hands of children, some quite old, most are run by serious people and are of value. The answer is not to be destructive, but to provide leadership. This is what I've been doing for many years in ham radio . . . it is what I am trying to do now. Unfortunately I'm not a very good organizer or leader . . . and Oh, how I wish I were, for if we had one good leader now we would have nothing to fear from the future. A good leader would gather all amateurs behind him, put an end to ARRL hanky-panky, and guide amateur radio into the 70's stronger than it ever was before. Sorry.

Don't miss Caveat Emptor on page 92.

Dear Wayne,

K5JKX's articles are always read with great interest, because they contain a great deal of useful information, but the noise figure treatise in October's issue contains statements which I believe to be slightly misleading. In an example he states the case of two receivers whose specifications list equal sensitivities in microvolts, but one has a 3 db better N.F. He then states that the receiver with the 3 db advantage in N.F. will receive signals with a better signal-to-noise ratio. He is only partially correct; sensitivity is given and defined as the signal strength in microvolts (or any other common unit, such as dbm) required to produce a given s.n.r. at a given bandwidth. The N.F.'s quoted in his example, 3 db and 6 db, do nothing more than specify the relative noise bandwidths of the receivers (i.e., the 3 db receiver has twice the bandwidth of the 6 db receiver). However, and this is the point which has been overlooked, the 3 db receiver is *capable* of producing a better s.n.r. if the two receivers had equal bandwidths, or if the bandwidth were variable to suit the bandwidth requirements of the received signal and the desired reproduction fidelity. In most current amateur receivers, the bandwidth is fixed by a crystal filter, so if its sensitivity in microvolts is specified, this effectively defines its capability, and knowing the N.F. is not an increase in useful information.

In fact, the N.F. may easily be calculated knowing the bandwidth and sensitivity. First of all, let's assume an input impedance of 50 ohms so that microvolts may be converted to dbm (db below one microwatt). Also, let's say our receiver has a two kc bandwidth and requires a 0.1 microvolt signal to produce a 10 db s.n.r. Point one microvolts into 50 ohms is $(0.1 \times 10^{-6})^2/50 = 2 \times 10^{-16}$ watts, or 2×10^{-13} milliwatts. This in turn is —127 dbm. Noise equivalent power is commonly given as —11 dbm/mc. (This is another way of stating kTB at room temperature and 1 mc bandwidth. A bandwidth shape following a Gaussian distribution curve is of course implied, but the difference in effective noise bandwidth arising from our crystal filter shape factor is ignored for simplicity.) To complete the numbers required in our calculation, we must calculate the bandwidth in db for 2 kc relative to 1 mc. This is $2 \times 10^3/1 \times 10^6 = 2 \times 10^{-3}$ or —27 db. Noise figure may now be computed as follows:

$$\text{N.F.} = 114 - \text{B.W.(db)} - \text{s.n.r.} + \text{sensitivity(dbm)}$$
$$= 114 - (-27) - 10 + (-127)$$
$$= 4 \text{ db}$$

Noise figure is therefore a measure of a receiver's *capability*, but not of its *performance* under a given set of fixed conditions.

Ted Bergstrom, W1IQW
Ipswich, Massachusetts

Dear Wayne,

For a 73 "Stray" to counter the one by W2DTE, local bookstores here sell QST's and CQ's at two for a nickle, but no 73' since your readers in this area won't let them go. Honestly.

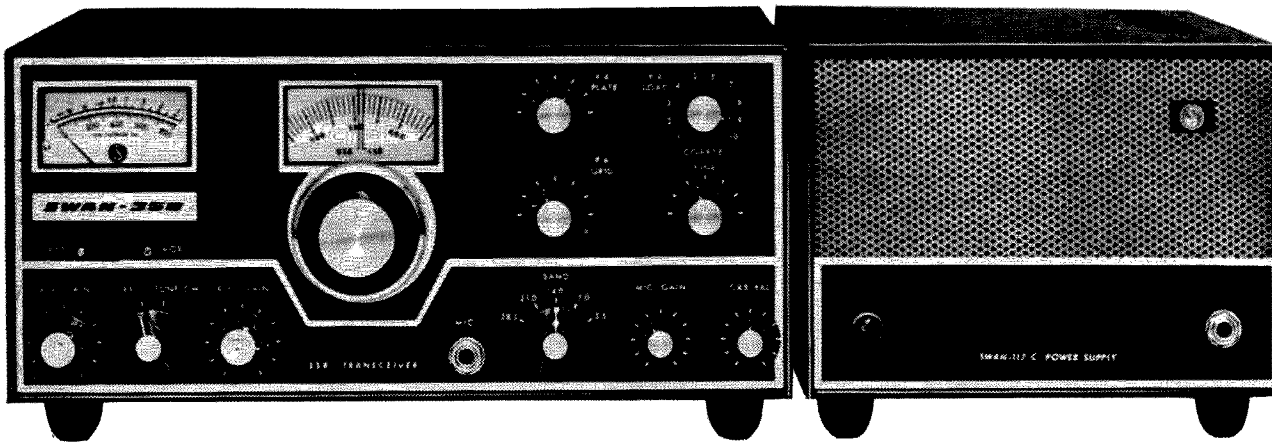
Bob Suerstedt WA6VAT
San Pablo, California

There is a good reason why the store on Sixth Avenue in New York doesn't have 73. Most of the magazines sold by used magazine stores are returns from the newsstands with part of their covers removed for refund by the magazine. Newsstand distributors tear a corner off the cover, return it to the publisher for credit and then selll the magazines for a penny or two to stores. 73 is not handled by a newsstand distributor so you won't find them in these stores.

Dear Wayne,

Keep up the good work Wayne. I love those editorials. Washington News makes amusing reading and since it is being sent to all IoAR members, how about suggesting that they use bigger type? Hi. Keep mentioning the names of advertisers who have dropped their ads because of your editorial policy. I certainly don't want to buy from someone where I'm not wanted.

Frank Nankin K4BNZ
IoAR Founding Member #301

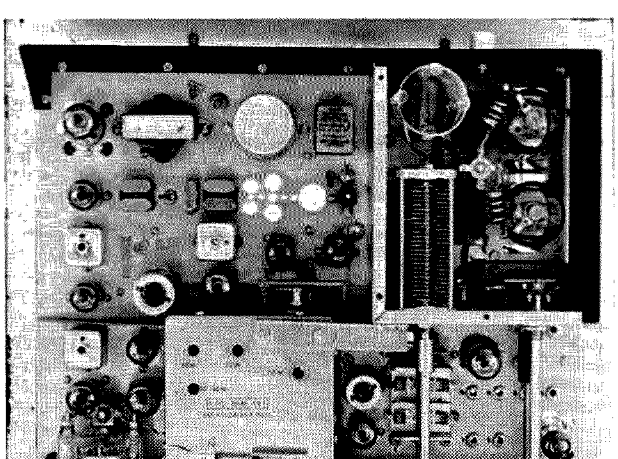


The Swan 350

Bill Siefkin WB6KEH

Excellent is the word for the new Swan 350 transceiver. The boys in Oceanside seem to have endless ability for producing top quality, economical, high performance single sideband transceivers.

Basically, the Swan 350 is a single sideband transceiver providing complete SSB or CW coverage of the 80-15 meter bands and one 500 kc portion of the 10 meter band. An optional modification kit is available for complete coverage of the 10 meter band. AM operation is accomplished by zero-beating the received signal and inserting a carrier into the transmitted sideband emission.



The receiver is the reliable single conversion design that is found in the Swan 100 and 240 series. The dual ratio tuning has that expensive feel to it, which is characteristic of the engineering excellence built into this rig. The transistorized VFO is temperature and voltage stabilized. Push-to-talk operation is provided, and an optional VOX accessory is available.

It weighs only 17¼ lbs and measures but 5½ × 13 × 11 in. It is ideal for convenient fixed, portable, or mobile installations. The unit runs over 400 watts PEP on SSB, 320 watts dc input on CW, and 125 watts dc on AM. The transceiver provides automatic gain control (AGC), automatic level control (ALC), and grid-block CW keying. Recommended power supplies are the Model 117C for ac operation, and Model 412 for 12-volt dc operation.

The transceiver uses 15 tubes, voltage regulator, two transistors, and five diodes. A 6GK6 drives two AB_1 6HF5s. Unwanted sideband suppression is down 40 db, carrier suppression is at least 50 db, and third order distortion is down 30 db. A lighted combination power amplifier cathode current and "S" meter is provided.

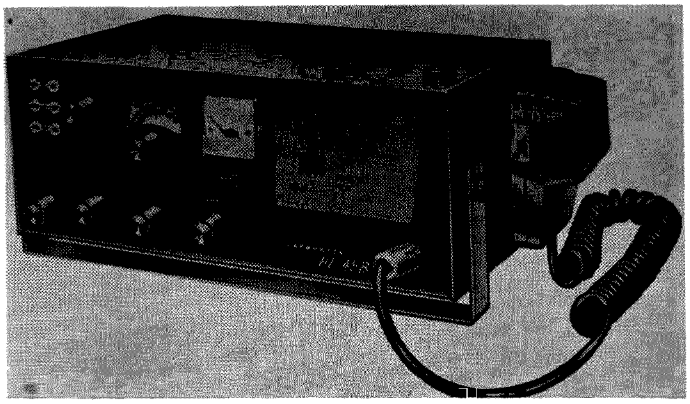
During the first weekend of operation, I worked 12 states, an XE2, KL7, and KH6. Sideband and carrier suppression, distortion, audio quality, and signal width reports were highly satisfactory. I don't miss VOX. I'd just as soon have a rig that is not "fully automatic." 599 reports on CW were common across the country.

The new Swan 350 represents an outstanding value in amateur communications. The prices are only $395 for the transceiver, $85 for the ac supply, and $130 for the transistorized dc supply. The circuit is completely hand wired, except for a portion of the VFO.

Considering performance, reliability, craftsmanship, and price, I believe one could not go wrong in investing in this excellent piece of amateur communications equipment.

. . . WB6KEH

Lafayette HE-45B



A. A. Wicks K3VHK/6
23045 Altamead Drive
Mountain View, California

Although not a recent market item, the Lafayette HE-45B has received little publicity since being modified from the HE-45. Nevertheless, this compact unit is a real sleeper. It deserves the attention of the six-meter enthusiast for fixed or mobile use or both.

The transceiver as received from Lafayette is complete. You can be on the air within five minutes of unpacking if you have an antenna up! A good ceramic push-to-talk microphone with AC and DC cables and plugs (already wired), a crystal for 50.124 mc, and a detachable mounting bracket are included. The latter may be left on when used as a fixed station, permitting the unit to face the operator with the slope of the panel adjustable. For mobile operation, the bracket provides the main support for underdash mounting. An additional rear strap support (which may not be needed) is also supplied.

The unit is attractive. It even met the approval of my XYL. It measures but 12 inches wide by 5 inches high, so the unit requires very little space in a standard size car and would even fit well in a compact.

Operating controls are functional. They provide all of the necessities without complicating mobile operation. However, tune-up for maximum output cannot be accomplished easily while in motion. Once the transmitter is peaked for maximum output on one frequency, the only controls that need touching are the receiver dial and volume control. An rf peaking control in the secondary of the 50.2 mc rf bandpass transformer is quite sharp, but once peaked does not need retuning over about a 2 mc range. The series-gate noise limiter is very effective, and is best left in full operation when mobile (if not for your own car, then for others). Noise is completely eliminated by the limiter in my 1960 Chevrolet, which has just the usual auto radio noise-suppression capacitors (generator, etc.), and no spark plug suppression. The noise control also functions as a convenient push-on, push-off standby switch. Two crystal sockets and a VFO socket are provided. Front panel switching of these three positions is provided. Power for a VFO may be obtained from a receptacle on the rear apron. It is designed for the Lafayette HE-61A 6-meter VFO, but many other VFO's can be used. A spotting switch completes the crystal oscillator (or VFO) circuit in the receive position. One other switch al

lows the meter on the transceiver to function either as an S-meter or relative power output meter. The S-meter is conservative.

Tuning-up is relatively simple. The usual pi-network output circuit permits just about any piece of wire to load. Tuning to resonance (maximum reading on panel milliameter marked Prf) is done with a front panel knob marked TANK. Loading is then performed by working on a screwdriver slot capacitor through a hole in the front panel. It is convenient to put a small knob on the loading control because this tuning is sufficiently sharp that retuning is necessary even when changing frequency a few kilocycles.

The same power input receptacle is used for both mobile and fixed operation, but the fused mobile power cable is terminated on one end with a cigaret lighter plug. This plug was removed in our installation, and a permanent connection made to an underdash spare fuse block.

The receiver is very adequate, with a sensitivity of 1 microvolt, and selectivity 3 kc at 6 db down. Image rejection is 45 db. Three *if* stages are incorporated, and a tuned rf bandpass stage ahead of the detector provides additional selectivity.

The transmitter portion of the unit is entirely separate in circuitry from the receiver except for the modulator. Half of a 6AW8 is used as an oscillator (buffer on VFO), with the crystal/vfo frequency-tripling in a second half. The 2E26 output tube operating Class C runs at 15 watts input. The modulator uses a 6EA8 as a speech amplifier with a 7868 doubling as a screen modulator for the 2E26 and as receiver audio output.

The power supply uses silicon rectifiers. For mobile operation, a 12-volt vibrator is used.

Performance was excellent over a three-month period operating from Pennsylvania to California. When 6-meter activity was found, contacts were made without difficulty with excellent reports both as to quantity and excellent quality of the signal. Contacts have been made consistently up to 15 miles mobile, and in some areas contacts were made in motion at distances of up to 60 miles with S7 to S9+ reports normal. In all of the mobile contacts the antenna used has been a front-cowl mounted New-Tronics NB-40 vertical antenna. In fixed operation during a recent band opening with a ground plane antenna 20 feet up, a good contact was made California-to-Colorado.

The HB-45B at $119.95 f.o.b. Syosset represents an excellent buy.

. . . K3JHK/6

Reciprocation?

No, not yet. The RSGB did manage a good coup when they got permission from the Post Office to permit foreign amateurs to operate the amateur stations at their recent RSGB exhibition in London. Shown here are Jeff Stone G3FZL, the President of RSGB, John Boyce G4NI, Chet Lambert W4WDR, the first foreign operator of GB3RS (first contact was with DJ8SW), and logging this memorable event is the Exhibition Secretary Ron Vaughn G3FRV.

(de W2NSD/1 from page 4)

lared for me to come see. It was an awful sight. The 48 element beam was lying in a mangled heap about thirty feet from the tower. The two inch seamless hardened steel mast which we had sent all the way to New York for had sheared off right at the top of the tower. That ice storm had been too much for it. We looked over at the next tower and the 432 mc 96 element beam was now in moonbounce position, having bent over to a 90° angle. Drat.

Reminds me of Sam Harris' postulate . . . if your antennas stay up more than a year they weren't big enough.

LMRE vs ARRL

There seems to be some skull-duggery going on here too. Apparently the top staff at HQ is still brooding over the IARU fiasco for I have reports that they seem to be working with ARAM, an anti-LMRE (Mexican Amateur Radio League) group.

Infamous?

The other day a letter came in that caught my eye. It was addressed to Wayne Green, 73 Ville, N. H. It got here promptly too. I don't know how they did it, but they did.

London May 29th

There will be an SSB Dinner in London on May 29th for those of you who are reasonably portable. It will be held at the Waldorf Hotel, Aldwych, London WC2. Food, entertainment, equipment displays and prizes are promised. Write to Norman Fitch G3FPK, 79 Murchison Road, London E10. Apparently several W's are planning on being there . . . how about you?

Outstanding W1 Award

Nominations are in order for the outstanding New England ham who has performed a meritorious public service to his community through the medium of amateur radio or made a major contribution to the science of amateur radio or helped greatly to stimulate interest in amateur radio in others or aided other radio amateurs to acquire a greater knowledge and skill in operating or building amateur radio equipment. Send complete and accurate nominations to Eli Nannis W1HKG, 37 Lowel Street, Malden, Mass. before March 26th. The award will be presented at the Swampscot Convention, April 24-25.

. . . Wayne

Dick Dundon W7LIA/WA4VVE

Putting the SB-33 on AM

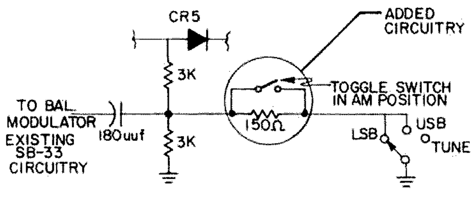
Putting a SSB transmitter on AM usually involves unbalancing the carrier in the low level stages. The SB-33 transceiver can be put on AM very easily and economically by unbalancing the carrier in a manner similar to that used when the transceiver is in the "tune" position. The only parts needed are a 150 ohm ½watt resistor and a sub-miniature spst toggle switch.

Modification

The modification can be done as follows:

Take the case from the chassis by removing the (4) screws on the bottom and sliding the case off the chassis while the chassis is held with the panel side up.

Layout the toggle switch location to suit the particular sized switch you intend to install. It is recommended that a sub-miniature spdt micro-switch be used, because of its small size; however, a standard size toggle switch can be fitted in place with careful attention to locating the switch between the plastic frequency dial plate and the left hand side (as viewed from the front) of the exciter tuning condenser.



Drill the hole for the toggle switch with extreme care. Do not drill through the front panel more than ¼ inch because you will damage components on the chassis.

On the bench, make a sub assembly of the toggle switch, the 150 ohm resistor and a two inch piece of hook-up wire. When properly assembled, the toggle switch shorts out the resistor.

On the SB-33 function switch (LSB, USB, TUNE) locate the white *unshielded* wire. This wire comes from the under-chassis junction of (2) 3000 ohm resistors and (1) 180 mmfd condensor.

Transfer this wire from the function switch to the toggle switch and solder.

Install the toggle switch by feeding the two inch piece of hook-up wire up through the function switch to the switch terminal formerly occupied by the white unshielded lead named above.

Solder the two inch lead from the toggle switch to the function switch. Check all solder joints and see that all wires are in the clear.

Checkout

Before re-assembling the case and the chassis perform the following checks. A dummy load or resonant antenna is required. It is recommended that a receiver with an "S" meter be available, also.

Tune up the SB-33 on 75 meters according to the manufacturer's instructions. Note: The "AM" switch is not in the circuit when the SB-33 is in the "Tune" position. Switch the SB-33 to either LSB or USB. With the "AM" switch in the AM position, the plate meter should read 150 ma to 160 ma. (This is 1.5 to 1.6 on the current scale.) With the AM switch in the SSB position, the current should drop to approximately 80 ma or 90 ma. (This is .8 to .9 on the current scale.)

With the SB-33 in SSB position, rechec the carrier balance per manufacturer's instructions. A quick carrier balance check can be made by listening for carrier with a communication receiver. The SB-33 should be in SSB position with the mike gain turned off. Rebalancing may be required. After checkout of the added AM switch, it is recommended that suitable decals be added to the fron panel to note AM and SSB.

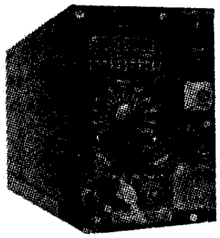
Operation

If operating in the SSB position, it is onl necessary to switch the AM switch to AM an reduce the audio gain approximately half. It is extremely important that when in the AM position, you *reduce* the audio gain approximately half so that the meter only occasionall flicks on modulation peaks. Remember, in the AM position too much audio will cause extreme distortion and practically eliminate al intelligibility.

According to the manufacturer's specifications the SB-33 delivers 150 watts PEP input and approximately 70 watts output. In the AM position you are expending approximately 100 watts input and will realize approximately 25 to 30 watts output (or that of an AF67 or G77A). . . . W7LIA/WA4VVE

FEBRUARY SPECIALS.

Pre-hamfest season savings, on our best sellers. Prices good to Mar. 31, back to normal Apr. 1.



IP-274/ALA-10 2 meter pan-adapter. 30 MC input, 10 MC band width; 400 cycle power supply. Complete with 3BP-1 CRT, all tubes, schematic instructions for conversion to solid state 60 cycle power supply; and to 18 MC input, if desired. Or see June 1964 issue of 73. Very excellent used. **$30.00**

Ni-Cad Batteries — 1.2v DC @ 4 amp-hour. 3/16 x 2 x 6". Removed from cases of 24 for 28v use. Excellent, GUARANTEED. **$1.50 ea. 10/$14.** — **case of 24 $32.50**

Range Filter — Has 3 position switch: "range" passes 1020 cycle only; "voice" rejects 1020 cycle; "both" no filtering. Cord with PL-55 and two jacks. For 600 ohm line. BRAND NEW. 3 LBS. — **$1.75**

Pi-Net Capacitor — 5 gang, 402 mmf/sec. 600v DC spaced. Will load output side of pi-network, even 160 meter, without inductance. Hande a KW. 3/16 x 1" shaft. Clean-good takeouts. 3 pounds. With 60:1 right angle worm gear drive **$2.25** — **less drive $1.80**

902A — 2" CRT, takes 600v DC maximum on deflection plates. Fits octal socket. BRAND NEW, dated 1963 — **$3.00**

IMPORTANT NOTICE.

Because of 30% increase in price of brass, my cost on co-ax connectors upped average 10%. I'll hold prices as long as possible, but must be, until conditions are stabilized, SUBJECT to CHANGE without NOTICE.

PL-259 or SO-239, **35c** ea. **12/$3.75**; DOUBLE MALES—**Don't Bind 89c** ea.; PL-258, double female **65c** ea.; M-359, right angle, surplus, **39c, 3/$1.10**; UG-175/U or UG-176/U, reducers, **11c** ea., **10/$1.00**; M-358 "T" **$1.75** ea.

All orders, except in emergency or I'm at a hamfest, shipped same day received. For free "GOODIE" sheet, send self addressed stamped envelope—PLEASE, PLEASE—include sufficient for postage & insurance. Any excess returned with order.

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TS726/UPM8 Tests APX6 W/27 Tubes, 10 Diodes GOOD 14.50
UPM8 Manual Navships 91537A ....Postpaid NEW 2.90
RT18/ARC1 100-156mc Xceivr. W/tubes & DN9 ..GOOD 19.75
COLLINS TCS Recvr 1.5-12mc in 3 bands ....EX 32.75
COLLINS TCS Xmittr 20W F one 40W CW 1.5-12mc. GD 22.75
C45 Control Box for ARC1 and ARC12 X'ceivers..GOOD 1.35
T465/ALT7 Xmittr 168-352mc W/2-8161s, 100W out. EX 22.50
Schematic for T465/ALT7 with parts values 1.00
Tube Type 6161 W/Plate, Grid, Cathode, Heater Connectors.
100 watts o'put to 900mc, 63 watts to 2000mc. ....EX 7.50
SWR Bridge. Micromatch-Reflectometer, 50-1000mc. EX 8.25
RBS 115V 60cy Pow. Supply & Audio Amplifier ...GD 14.25
Set of 120 Xtals, Type FT243 5675 kc thru 8650 kc in
25 kc increments, US tested & packed 120/17.75
HV Probe 50 KV Insulation, 500 meg series res. ..NEW 8.45
Meter, Weston Model 843 500-0-500 microamp. 3" ..EX 8.85
Meter, Phaostron, 2½". 100-0-100 microamps ....GOOD 4.00
Meter, Burlington, 2", 0-150 volts AC ....GOOD 2.25
RE2/ARC5 Ant Relay W/Meter & Vacuum Capacitor EX 1.85
T19-6.75 T20-4.75 T21-4.75 T22-8.75 ....ALL GOOD
APX1 less tubes. 30lbs of high quality parts ....GOOD 2.75
Tuning Unit for APX1 with 3 tubes ....GOOD 1.00
APN1 Xceivr 420 mc W/Wobulator. Less tubes....GOOD 3.85
R122A/ARN12 75 mc Superhet w/9 tubes & xtal ... EX 3.85
IC/VRW7 Wire Recorder. 28 VDC. W/Tubes ....GOOD 4.50
UPM11A AFC Chassis W/8 tubes & schematic ....NEW 3.75

E. C. HAYDEN

BOX 294 Bay Saint Louis Mississippi

Shipment: FOB Bay Saint Louis. Terms: Net, Cash.

CAVEAT EMPTOR?

We've had so many requests from 73 readers for a want ad section that we're starting one—against our better judgment. After all, we're dreadfully overworked now and are bound to have even more of a headache handling all those tiny ads. But you say you want it, so please follow these instructions when you submit ads:

- ★ Price—$2 per 25 words for non-commercial ads; $5 per 25 words for business ventures. No display ads or agency discount. Include your check with order.
- ★ Type copy on standard size paper. Phrase and punctuate exactly as you wish it to appear. No all-capital ads. Include your signature with order.
- ★ We can only accept ads related to ham radio. We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.
- ★ For $1 extra and an SASE, we can maintain a reply box for you.
- ★ We cannot check into each advertiser, so Caveat Emptor . . .

WANTED: all types Military, Commercial, Airborne Ground Electronics equipment-Testsets, GCR, PRC, Collins, Bendix, Others—We pay freight . . . RITCO P.O. 156, Annandale, Va.

QSL's $1.75/100. Eye-catching, different. Sparkling gold or silver printed on six exciting Hi-Gloss cardstock colors. Samples 5c. Nu-Print, Dept. A. 322 Page Boulevard Springfield, Mass.

SPECIAL in new and used amateur gear. We have i at an exceptional savings. Write or call Bob Grimes, 8 Aspen Road, Swampscott, Massachusetts, 617-598-2530

---

2 Springfield 6 m battery transceivers. $10 each. Lakeshor Phasemaster, Jr. $75. Heath Q-Multiplier, $5. Dumon 208 scope, $75. Dumont 573 scope, $40. Knight Spa Master, $6. 350AT xmtr-rcvr w/PS, $90. Lots more, wha do you need. W2NSD/1.

UNIT 6, 10KC Step Generator of SRT14 Freq Synthesizer, New, less tubes, W/Schematic, $8.00 Postpai Check W/order . . . RITCO, P.O. Box 156, Annandale, Va.

BC-1335A FM xcvr, $20. BC-1158 6 meter xmtr. Ver clean, $30. ARC-4 $20. ARC-12 less 2C39's and dyna motor, $25. TBY, 10. ARC 3 rcvr, $20. ART-26 complet $30. Partially converted, $27. K2YDD/1, P.O. Box 23 Jaffrey, N. H.

Sonar SRT-120P Transmitter, 10-80M, 120 watts, 100 watt phone, push-to-talk, built in power supply, 5984 fina VFO-Xtal, excellent condition, cost $300, will sell fo $125 complete. Box 151, 73 Magazine, Peterborough, N. H

Model 30A printer, made by Teletype Corp. Tiny ligh weight unit (19 lbs.), has 28-type keyboard, 115 va motor, end-of-line indicator, aluminum case. Exceller condition. Just the thing for portable operation and demon strations. $90. Box 152, 73 Magazine, Peterborough, N. H

Wide screen television camera and 18" monitor. Made b Grimson Color, Inc. Model 700. Sells for over $1000 nev Complete in excellent working condition, like new, wit all cables, power supplies, etc. $700. Box 153, 73 Magazine, Peterborough, N. H.

QSL cards, quality cards at reasonabl prices. Club decals. Bumper Stickers. Samples tn cents. Marion Hill W5HOW, Rt. #2, Box 1005, Humble, Texas.

FCV 2. Two meter converter in LMB box $13.00. FCV 2 six meter converter $13.00. BC 222 AM transceiver 25 mc to 55 mc battery operated, with handset $20.00. Two Motorola 30 watt FM xmtrs (part of two piece eqpmnt) on 6 meters @ $9.00. BC 611 handie talkie on 4467.5kc $22.00. Link hi band FM rcvr model #1905 $8.00. Cletus G. Reinsel W3WUA, Box 25, Bigler, Pa.

HRO5OT1 with four sets of coils and 100kc standard. Excellent condition. Can ship in original packing. $150. Collins 70E8A PTO with dial $40. B&W Multiplier 100watt $25. w/IB. R. G. Wilson, W3GHD, 139 Campbell Ave., Havertown, Penna.

HAM TV Deflection & Focus Coil Kit is now available with complete Instruction Manual of a 5 tube Vidicon Camera for only $19.90. Kit has 1 set of pre-formed vertical and horizontal coils with shielded coil form — prewound focus coil with target connector and inner shield and mu metal outer shield. ATV Research, P. O. Box 396, South Sioux City, Nebraska, 68776.

The third annual mid-winter Ham Swap and Shop will be held at the DuPage County Fairgrounds at Wheaton, Illinois on Sunday, Feb. 21. All amateurs, CB'ers, and hobbyists are invited to attend and to bring any equipment that they wish to swap or sell. $1.00 donation is payable at the door. For further information contact John Koranek, K9GTT, 505 East Ellinois Street, Wheaton, Illinois.

WANTED . . . Telephones . . . Crank, Dial or Touch-Tone, and associated equipment. Send post-card stating make, type, condition, and cost or trade wanted. K9LGJ, P. O. Box 11, Milton, Ind. 47357.

Elmac, AF-67 and PMR-7, xmitter converted to six meters, 160 meters removed, all Elmac power supplies included. Make offer. Anthony W. Cline, K1PNI, 133 Larchmont Road, Warwick, Rhode Island 02886.

TV CAMERAS for sale or trade for RTTY equipment. Two RCA TV Eye cameras complete with vidicon and lens plus instruction manual $150 each. K7KRP, 603 K Ave., LaGrande, Oregon.

FOR SALE: Ranger 1, $140, Hallicrafters S-40B, $50, Globe Scout 65B, $40, National NCX-3 and NCX-A, 350. All in excellent condition. K1APA, 3 Sunny Acres, Brattleboro, Vermont.

Radiophone pan-adapter for 455 kc. Clean $70. K9CUZ.

DUMMY LOAD, 50 ohms. All bands up to legal limit. Size, 3 x 4 x 7. Coax connector. Kit $7.75, wired $9.75 pp. Ham Kits. Bx 175, Cranford, N. J.

IARC

The International Amateur Radio Club at Geneva has announced a convention to be held September 17-19, 1965. Also, contributions are now solicited for the 1965 edition of 4U1ITU Calling" which will be published for the ITU Centenary, May 16-17. Send all material to IARC, Geneva 2, Switzerland. A special QSL will be available to all amateurs who contact 4U1ITU during this celebration. If you would like to operate 4U1ITU please write immediately.

Signal Corps Technical Manuals, Instruction books and other material pertaining to signal corp equipment and etc. Manuals are New or like new. All are shipped postpaid USA. If faster means desired, add additional money to cover cost. All shipped parcel post otherwise. Due to size and weight of some manuals, a higher price is asked.

TM 11-2234 Teletypewriter TT-4/TG	$1.50
TM 11-352 Printer TG-7-7-A and Teletypewriters TG-7-B and TG-37-B	$1.50
TM 11-2230 Teletypewriter Sets ANF/GC-20, AN/FGC-20x and AN/FGC-21	$2.00
TM 11-2246 Teletypewriter Sets AN/FGC-25 and AN/FGC-25X	$3.00
TM 11-2210 Teletypewriter TT-10/FG	$1.50
NAVY TECHNICAL MANUAL—Teletypewriters TT-47C/UG, TT-48B/UG, TT-69B/UG, TT-70C/UG, TT-128A/UG, TT-129A, TT-130A, TT-131A/UG, TT-171/UG, TT-234/SGA-3	$3.00
TM 11-957 Rectifier RA-87 (Teletype pwr supply)	$1.00
TM 11-264A Radio Set AN/GRC-26A (BC-610 schematic, H&I R-388/URR schematic, Freq. Shift Exciter Schematic	$1.50
TM 11-692C Radio Set AN/ARC-27	$2.25
Manual Illustrated Parts Breakdown Radio Set ARC type 12	$2.50
TM 11-605 Radio Sets SCR-509 and SCR-510	$1.25
TM 11-517 Radio Set AN/ARC-44	$2.50
TM 11-851 Radio Set SCR-244-D & Radio Receivers R-274A/FRR, R-274C, R-320A/FRC, R-483/FRR and R-483A (Sp-600 schematic	$2.25
Instruction Book Radio Transmitter T-278/U and T-416/GR	$1.50
TM-11-2671 Radio Transmitters Type 96A, 96C & 96C3 Wilcox	$1.75
Instruction Manual Radio Receiver R-392	$2.50
Instruction Manual Radio Set AN/GRC-19	$2.50
TM 11-5054 Speech Amplifier BC-614-E-F-H and I	$1.50
Instruction Manual Radio Set AN/GRC-10	$3.00
Instruction Manual Radio Sets AN/VRC-19-19X-19Y	$1.50
TM 11-621 Radio Set AN/GRC-41	$2.00
TM 11-1367 Radar Set AN/MPQ-4A	$2.00
Instruction Manual VHF Navigation Equipment ARC Type 15F	$2.50
TM 11-300 Frequency Meter Sets (BC-221) SCR-211-A-B-C-D-E-F-J-K-L-M-N-O-P-Q-R-T and AA-AC-AE-AF-AG-AH-AJ-AK-AL	$1.50
TM 11-2004 Repeater Set TC-18 (Terminal Telegraph)	$1.25
TM 11-2202 Manual Telephone Switchboard SB-22/PT	$1.50
TM 11-4313 Switchboards BD-91-A-B-C-D	$1.25

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SG-1, 2, 3, 12, URM-25, 26, 48, TS, BC-312, 342, 610, 669, ARC-27, 34, 52, TED, TCS, TRC-1, 8, SP-600, R-388, R-390, CV-43/APR-9, TN-131/APR-9 RT-66, 67, 68/GRC, R-108, 109, 110/GRC, RT-70/GRC, PRC-6, 8, 9 and 10 and any other military electronic gear that you may have to sell or trade.

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Propagation Chart

February 1965

EASTERN UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	3	3	3	7	7	7*	14	14	14
ARGENTINA	14	7#	7#	7	7	7	14	14	14*	21	21*	14
AUSTRALIA	14	7#	7#	7#	7#	7#	7	14	14	14	14	14
CANAL ZONE	14	7	7	7	7	7	7	14	21	21	21	14
ENGLAND	7	7	3	3	3	3*	14	14	14	14	14	7#
HAWAII	14	7#	7	7	7	7	7	7#	14	14	14*	14*
INDIA	7	7	3#	3#	3#	3#	14	14	14	7#	7#	7
JAPAN	14	7#	7#	7#	3*	3*	7	7	7#	7#	7#	14
MEXICO	14	7	7	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	7#	7#	7#	3#	3#	7	7	7	7#	7#	7*
PUERTO RICO	7	7	7	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	7	7	7	7#	7#	7#	14	14	21	14*	14*	14
U. S. S. R.	7	3	3	3	3#	3#	14	14	14	7#	7#	7
WEST COAST	14	7	7	7	7	7	7	14	14	14	21	14*

Good: 1-10, 12-17, 19-23
Fair: 11, 27-28
Poor: 18, 24-26
Es: 2, 8-9

CENTRAL UNITED STATES TO:

ALASKA	14	7	7	3	3	3	7	7	7*	14	14	14
ARGENTINA	14	7#	7#	7	7	7	14	14	14	21	21*	21
AUSTRALIA	14	14	7#	7#	7#	7#	7	7	14	14	14	14
CANAL ZONE	14	7	7	7	7	7	7	14	21	21	21	21
ENGLAND	7	7	7	3	3	3*	7	14	14	14	7#	7#
HAWAII	14	14	7#	7	7	7	7	7	14	14	14*	14*
INDIA	7	7	7#	7#	3#	3#	7#	14	7*	7#	7#	7
JAPAN	14	7#	7#	7#	3*	3*	7	7	7	7#	7#	14
MEXICO	14	7	7	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	7*	7#	7#	3#	3#	7	7	7	7#	7#	14
PUERTO RICO	14	7	7	7	7	7	14	14	14	14*	14	14
SOUTH AFRICA	7	7	7	7#	7#	7#	14	14	14*	14*	14*	14
U. S. S. R.	7	3	3	3	3#	3#	7#	14	14	7#	7#	7

J. H. Nelson

WESTERN UNITED STATES TO:

ALASKA	14	14	7	7	3	3	3	3	7	14	14	14
ARGENTINA	14	14	7#	7	7	7	7#	14	14	21	21*	21*
AUSTRALIA	21*	21*	14	7#	7#	7	7	7	14	14	14	14
CANAL ZONE	14	14	7	7	7	7	7	14	14	21	21*	21
ENGLAND	7	7	3	3	3	3#	7#	7#	14	14	7#	7#
HAWAII	21	14	14	7	7	7	7	7	14	14	21	21
INDIA	7#	14	7#	3#	3#	3#	7#	7*	7*	7	7#	7#
JAPAN	14	14	14	7#	7	7	7	7	7	7#	7#	14
MEXICO	14	7	7	7	7	7	7	7	14	14	14	14
PHILIPPINES	14*	14	14	7#	7#	7#	7	7	7	7#	7#	14
PUERTO RICO	14	7	7	7	7	7	7	14	14	21	21	14
SOUTH AFRICA	14	7	7	7#	7#	7#	7#	14	14	14*	14*	14
U. S. S. R.	7#	3#	3	3	3#	3#	7	7*	7*	7#	7#	7#
EAST COAST	14	7	7	7	7	7	7	14	14	14	21	14*

Very difficult circuit this hour.
* Next higher frequency may be useful this hour.

73

March 1965

40c

Amateur Radio

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ıagazine

ayne Green W2NSD/1
itor & Publisher

ul Franson WA4HWH/1
sistant Editor

arch, 1965

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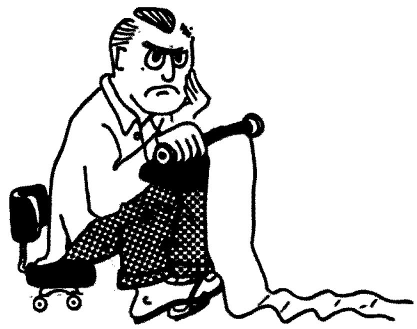


Docket 15640 (Conditional Class Modifications) has been adopted by the FCC. More on thi next month.

de W2NSD/1

never say die

Flying Sorcerers

All us lunatic fringe types have been sort of keeping track of the flying saucer disturbances. While never an avid saucerite, I have read a few of the books and listened to radio interviews with some of the "experts" and crackpots who have been taking the subject seriously. By bringing up saucers whenever I am in intelligent company I have gathered some interesting facts and surmises.

Thus it was not entirely out of character for me to bring them up during a slight lull while lunching with the Institute Interim Directors in Washington in late December. All of us seemed to feel about the same . . . open minds on saucer existence and wondering why, if they do exist, wo don't hear more about them.

One director was coming down with a cold that day and was away from work sick for the next few days. The first day he was back at work he was called to the office window by a friend and there were six saucers flying at about 10,000 feet right over Washington. All six people in the office crowded to the window and watched them proceed at a good clip across the sky and out of sight. Then six more came zipping across as they were frantically phoning friends to take a look. Quite a few people saw them quite clearly.

When they started trying to tell about it they found out why we hear so little about saucers. The Washington papers didn't want to touch the story. One TV station put on an interview with one of the six and high government pressure was immediately put on him and the other observers to keep quiet about everything. It is so ridiculous that I hesitate to report it, but they were told that the sight they had seen was classified since they had been in a government office building looking through government windows.

The motive behind all this hush-hush seems to be one of keeping the populace from a panic, not military secrecy. The government is haunted by the reaction to the Orson Welles radio program back on Halloween eve, 1938 when he dramatized the H. G. Wells fantas "The War of the Worlds." Thousands we hysterical . . . a woman in Pittsburgh w stopped as she prepared to take poison, sa ing, "I'd rather die this way than that."

Balderdash. A nation that has been able calmly accept the news that their almost un versal and virtually unshakable habit of smol ing cigarettes is inexorably leading them an early and extremely painful death certainl has the stamina to accept the no doubt hic eous monsters that are peering over ou shoulders.

Perhaps by next month we'll be able t struggle through the Pentagon red tape enoug to bring you a story from a very convince saucer fan, one of our Washington Institut Directors.

News Flashes

Just as I predicted, ARRL membership ha dropped off again in 1964 . . . even wors than it did in 1963. The membership seem to have dropped from some 84K down t under 79K, about 5000! One might suspec that something is wrong when they see th League fading away while the number o hams is ever increasing. One would be right

Of course the report from CQ is about th same. Perhaps this is an indication that thei coat-tail position to ARRL has not been a successful as they hoped. At any rate thei year end report for 1964 showed a drop o about 6000 copies average over a six month period! That, for your information, is one heck of a drop.

While CQ and QST were dropping in popularity I am happy to report that 73 has been steadily increasing, with an overall 10% growth for the year.

Monitor Expires

The Monitor has, alas, demised. The Monitor went along smoothly and calmly for many years providing operating news for hams in the Southwest and was gradually growing to serve most of the country. Then along came ARRL's submission of RM-499. The explosion of ham opinion against this high handed affair

erupted into the pages of The Monitor, gra ually easing out the operating news. On three amateur publications dared print pr and cons of 499: 73, The Moniter and K6BX Newsletter. The war was on. Tremendous pre sure was brought to bear by the League an soon all three of us began to find that a fe of the major advertisers were avoiding u The Monitor was forced under, K6BX w forced out of CQ and a few of the maj advertisers are conspicuous be their absen from 73. Fortunately we do not have to rel on ARRL's unofficial Board of Directors f our survival . . . the advertising results 7 provides bring us the smaller companies i a goodly number. For instance, one maj distributor wrote a few days ago to tell u that his ad in 73 outpulled his ad in QST b four to one . . . and I can't tell you wh another said about CQ. There I go gettin lousy again. But I'm angry . . . The Monit was doing our hobby a lot of good and hate to see them stamped out by Big Brothe

True or False?

One reader has written in to tell me that m long time friend and confidant Harry Dannal W2TUK, in the heat of the political race fo ARRL Director of the Hudson Division, ha intimated at ham club meetings that his op ponent Howard Wolfe W2AGW is a Com munist and, even worse, that he is someho connected with me.

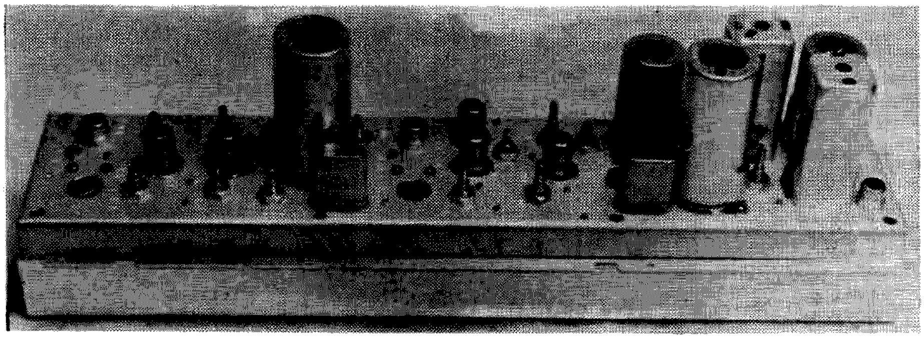
We would all like to hear more about th million dollar libel suit that Huntoon is ru mored to be fighting . . . and to know who i footing the bill for the very expensive la firm supposedly representing him? Does thi come out of that hundred thou?

I am given to understand that W1AW i still in full operation even though such opera tion is now obviously illegal with paid opera tors and absentee licensee. Tsk, tsk.

And what will happen to the QST ad rate now that the Internal Revenue Service ha decided that the advertising revenues of mag azines such as that are taxable? Another rat increase in the works? It would be a sham for QST to have to compete with us taxpayer on an equal footing and not reap their fan tastic tax advantages because they spend abou 10% of their income on public service.

Many of us are wondering who the Leagu will hire for public relations to help improv their image after the jolt it received ove RM-499 . . . we hear they are looking. Per haps this would help stop the reported alarm ing drop in membership.

Continued on p. 86.



John Wonsowicz W9DUT
4227 N. Oriole Ave.
Norridge, Illinois

Photo work by W9JFW John R. Wonsowicz

Dual VHF Converter

The Nuvistor converter about to be described was designed for a critical vhf man. This converter has a good noise figure, ample gain and bandwidth, and is also economical to build. The dual converters reduce costs and space appreciably over two single converters.

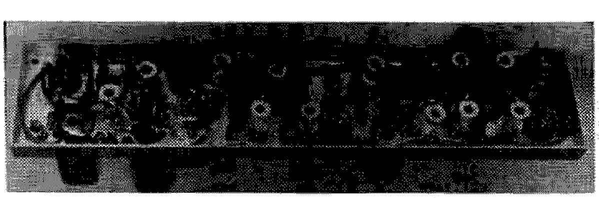
On 220 mc the noise figure is between 3 and 4 db; over-all gain is 60 db; and the bandwidth is within 2 db of being flat from 220 to 225 mc.

On 144 mc the noise figure is between 2 and 3 db; over-all gain is 50 db and the bandwidth is ±1 db over the tuning range of 144 to 148 mc. Sensitivity in both units is .1 microvolts.

Construction

Follow the schematic and parts layout closely and you should encounter no trouble. If difficulty is found in either of the converters, a close recheck of components and wiring in each stage should uncover the fault. Usually a mere oversight by an impatient builder causes disappointment, so double check all components and examine all connections for cold joints.

The unit described was built on a homebrew chassis, but it is advisable to use a commercial chassis unless you can use a fair sized brake. The suggested commercial chassis is a Bud CU-3014-A Minibox that measures 12" × 2½" × 2¼" and is made of natural aluminum. Use the "narrow sides" section as the chassis and the "wide sides" part as the cover or bottom shield.



Bottom view of converter.

The drilling template was made for this module showing the Bud chassis. The photos show the placement of components.

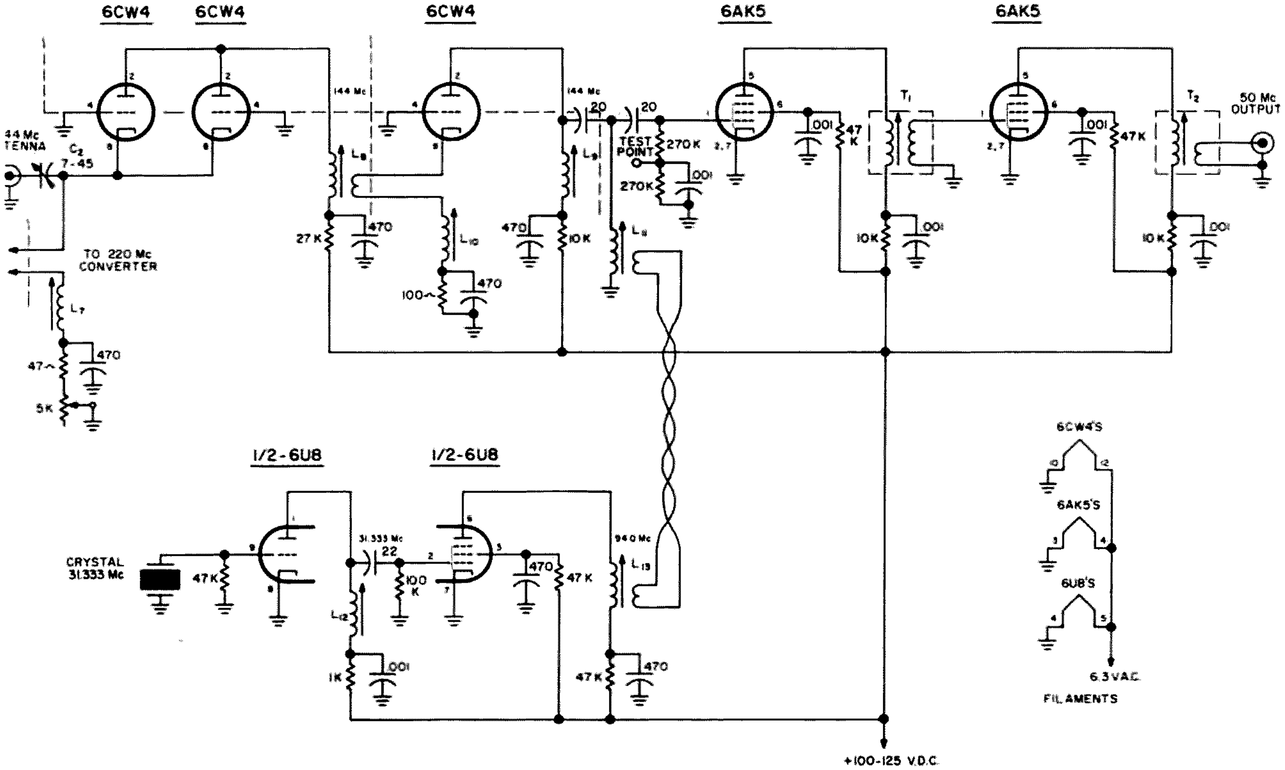
Circuit

The 220 mc converter has a 144 mc output that feeds into the cathode of the tandem 6CW4 Nuvistors of the 2 meter converter. The first Nuvistor in the 220 mc section operates as a grounded grid amplifier and the signal is fed to the cathode through a ceramic trimmer. Signal output is taken at the plate through a link and fed to L3 which is the grid coil of the second 6CW4 used as a triode mixer. You will notice that shields are provided between all 220 mc tuned circuits to prevent regeneration.

Needless to say, the gain of one grounded grid stage and a triode mixer is not very high. However, the signal is amplified sufficiently by the following 2 meter converter.

The local oscillator tube is a 6U8. The triode section is a crystal oscillator with its plate tuned to 25.333 mc. The pentode section of this tube is the tripler to 76 mc. The output of this section is coupled to the grid of the mixer by a 3 pf ceramic capacitor.

In the 144 mc section, we start with a link in series with the cathode coil of the tandem rf stage Nuvistors. The antenna is fed through a ceramic trimmer to the high side of



144 Mc CONVERTER

Coil Data
All coil forms—J. W. Miller No. 41A000CBI

lo.	Freq.	No. Turns	Wire	Winding	Remarks
. 1	220 MC.	2½ T	#22	Spaced 1w dia.	
. 2	"	2½ T	#22	" "	3T. Link
. 3	"	3 T	#22	" "	3T. "
. 4	144 MC.	4½ T	#24	" "	
. 5	76 MC.	6 T	#24	Close wound	
. 6	25.3 MC.	20 T	#28	" "	
. 7	144 MC.	3 T	#24	Spaced 1w dia.	
. 8	"	4½ T	#24	" "	3T. Link
. 9	"	6 T	#24	" "	
.10	"	4 T	#24	" "	
.11	"	4½ T	#24	Spaced 1w dia.	3T. Link
.12	31.3 MC.	16 T	#26	Close wound	
.13	94. MC.	6 T	#24	" "	3T. Link

TI = J. W. Miller I.F. Trans. No. 6233 Modified 45.5 MC TV Trans. (remove 3 turns from coils).
T2 = J. W. Miller Trans. No. 6231 Modified 44 MC TV Trans. (remove 3 turns from coils).

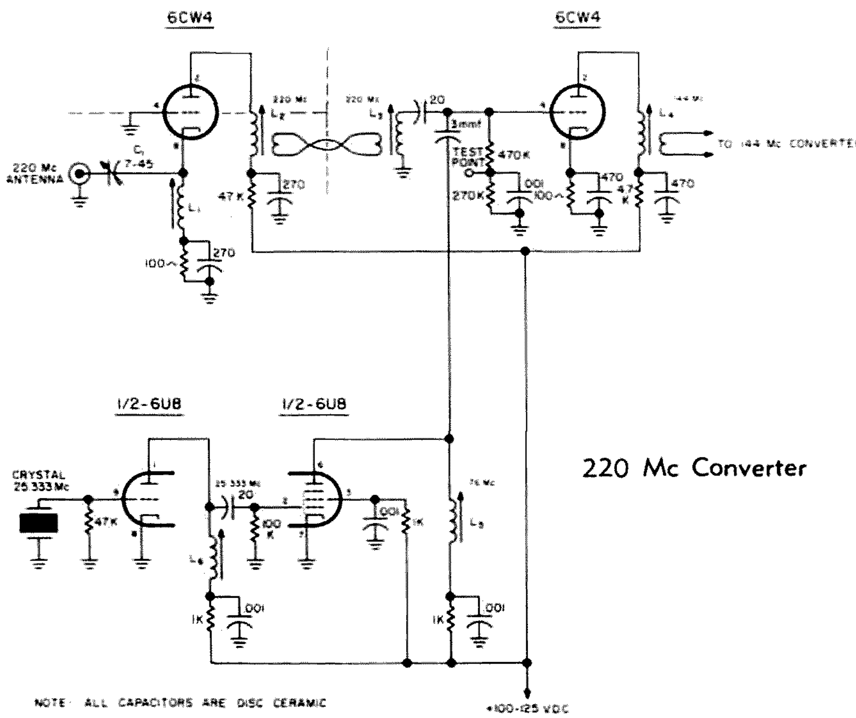
he link as shown on the schematic. The cold ide of the cathode coil is by-passed with a 70 pf ceramic capacitor and is connected to 47 ohm resistor. This resistor is connected o the 5000 ohm rf gain control. This control s not essential, but it helps prevent overloadng on strong signals. Similarly, the plate cir-uit of this grounded grid amplifier is link oupled to the cathode of the second stage.)utput of the second grounded grid amplifier s coupled to the mixer grid through a 20 pf eramic capacitor. The mixer is a 6AK5. Its utput is fed to a stage of *if* amplification at 0 mc.

The oscillator circuit is similar to the 220 nc one. Differences are the frequencies of the uned circuits and crystal.

The *if* amplifier is also a 6AK5 and operates at relatively low plate and screen voltage. The output of this amplifier is taken off the link in T2 and connects to the output connector shown on the photo. Transformer T2 is a J. W. Miller No. 6231.

Notice that the B+ supply voltage is between 100 and 125 volts. This low supply voltage is essential in reducing over-all noise of the converters without sacrificing sensitivity. A good way to secure such voltages is a 108 volt regulator tube such as an OB2. This regulator tube can be mounted on the back of this converter chassis or on the power supply chassis.

The complete unit draws a maximum current of 20 ma at 108 volts. In the 2 meter



220 Mc Converter

position the current drawn is only 15 ma because the 220 mc section is made inoperative.

One way to cut off the 220 mc unit is to use a rotary switch and simultaneously switch the antennas and the B+ to the converters.

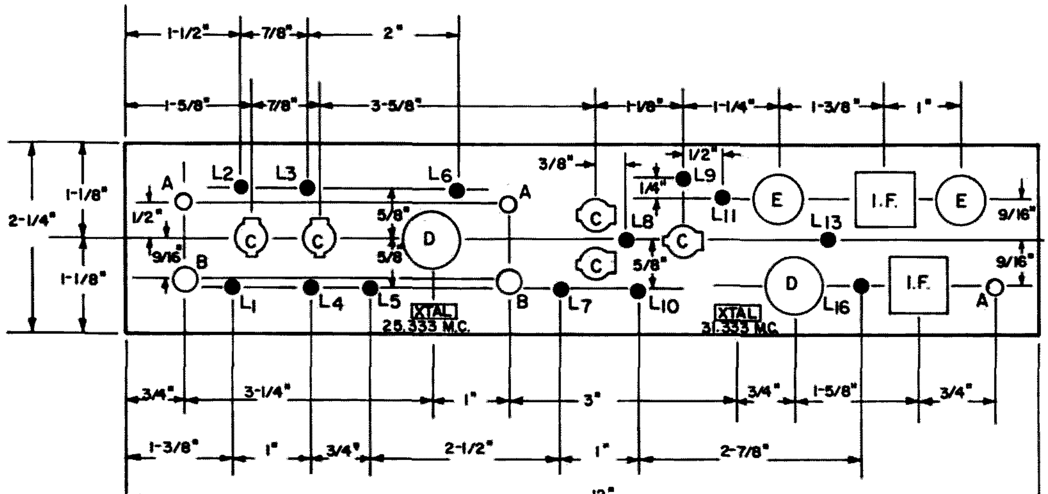
Tuning

Tuning of the converters is quite standard and follows a definite pattern. Use a dip meter to get all coils on frequency. If necessary, alter the coils by adding or eliminating a few turns or by adding a little capacitance across the coils that are too high. This won't be necessary if you follow the layout.

Be sure to short all coils near the one being dipped. Otherwise you may dip the wrong coil.

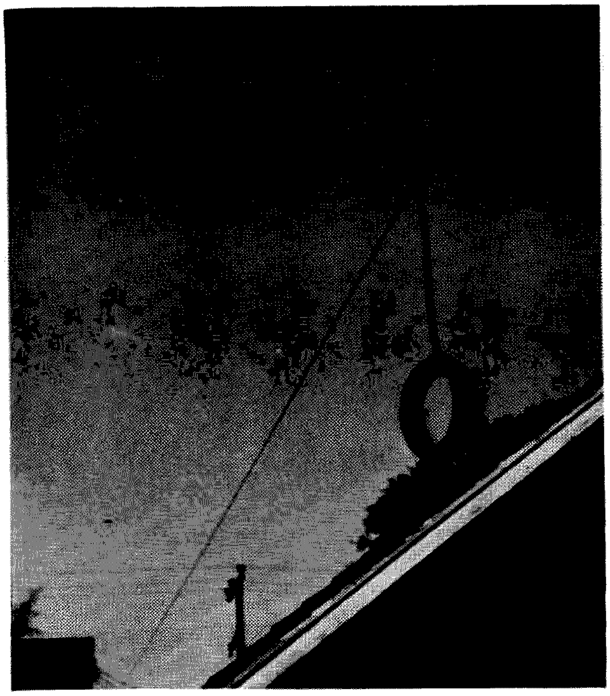
After all coils are on frequency, re-check all wiring and all component values. Connect the *if* output of the converter to a 6 meter receiver. Connect the 2 meter antenna to the 144 mc converter section and apply voltage to this section. Check the oscillator by using the grid dipper in the detector position. If the oscillator is working, the meter on the grid dipper will swing upward. Now tune in a strong signal (or use a signal from the dipper in modulated position) and peak all 2 meter coils and the *if* transformers. After this is done tune in a weak signal and re-peak all coils for maximum gain except L7 and C2. These two are adjusted for the lowest noise and best signal quality.

After adjusting the 2 meter converter, remove the antenna from the input jack and connect an antenna to the 220 mc section. Apply power and check the activity of the oscillator. Then proceed to make adjustments as in the 144 mc section.



Drilling Template

. . . W9DUT



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Klamath Falls, Oregor

A Two Band Collinear

for the ham with a little real estate

The advantages of assorted long wire antennas are well known. And we would be the first to acknowledge that their chief disadvantage is that they are just a wee bit difficult to rotate. However, many of us live where bidirectional properties will just about do the job that we want to do. From the location of W7CSD a good north-south pattern on 40 meters is highly desirable and a four leaf clover pattern on 15 isn't bad either.

A 300 foot East West long wire had been in use for some years with varied amounts of success; however, changing bands was cumbersome from the standpoint of retuning. With the rise of interest in 40 meter beams we decided to cut the long wire into four half wave sections phased *in phase* with quarter wave stubs between the sections. See Fig. 1. It will be noted that a one quarter wave on 7 mc becomes a three quarter wave on 21 mc. This will also give in phase operation. On 21 mc, instead of four half waves in phase, we have four one and one half waves in phase. This gives the familiar four leaf clover of the one and one half wave long wire re-inforced four times which makes the ears a little sharper. This covers parts of the Pacific Northwest and Southwest. New Zealand and Japan are hit about dead center.

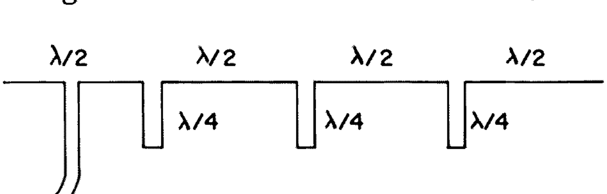


FIG. I

Quarter wave stubs: A quarter wave in free space on 40 meters is on the order of 33 feet. To have three 33 foot sections hanging in the breeze presents some problems both mechanical and aesthetic. The XYL will probably take a dim view of such procedure. If you use 300 ohm twin lead, the length will be shortened to something like 25 or 26 feet but is still unsightly. However, it is possible to coil the twin lead up so that it hangs in a 5 or 6 inch diameter coil directly below the flat top. It is impossible in either case to measure with a ruler. Measurements must be made with a grid dipper. If the shorted end is shaped so that it will fit over the

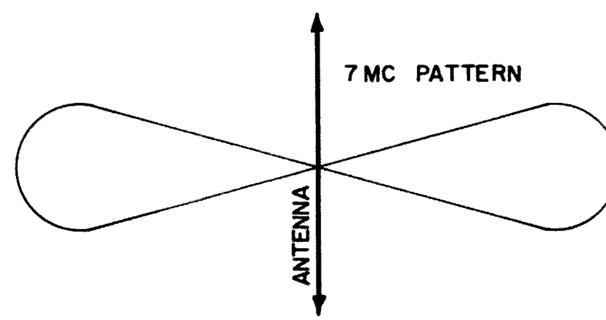


FIG.2

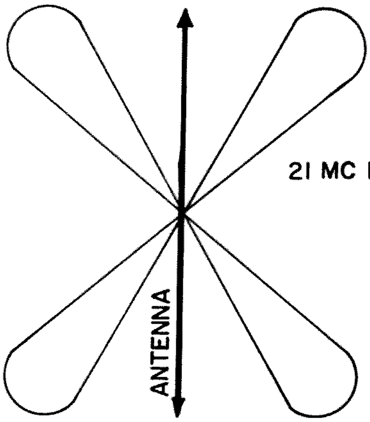


FIG. 3

ɔil on the grid dipper, a very sharp dip ·ill occur at the frequency corresponding to ıat for a quarter wave length (or three quarɜr wave length) stub. All that is necessary is) set the griddipper on the proper frequency nd start cutting with the diagonals. It was ɔund that on approximately 6 inch diameter ɔil, with a foot and a half hanging out to ·im, 23 feet was pretty close. A little trial n the first stub will determine the necessary ɜngth to wind up.

Feed point resistance: It would probably e highly desirable to feed the antenna some·here near the center, but in our case, the ɜed point nearest the ham shack was the enter of the first half wave section. We were ı doubt about the impedance that would exıt. A Heath antenna impedance meter was ılaced at this point and the antenna raised to . little less than its normal height (to be ble to manipulate the meter). Strangely nough the impedance turned out to be a little .nder 100 ohms on both the 7 mc and 21 mc ·ands. So we decided to use 72 ohm transıission line.

Field pattern and operation: Figs. 2 and 3 ıdicate the expected field pattern. No accuate field strength measuring equipment was vailable to prove the exact patterns. Upon he completion of the antenna, we put a forty ıeter 20 watts input phone rig on the air. Number one contact was Vancouver, B.C. nd number 3 contact was San Diego, Calif. ʒoth were 100% QSO's in the middle of the fternoon. 15 meters has not been consistent nough to make any broad sweeping stateɑents, but running about 250 watts NBFM eports have been good down Texas way and ven as far north as Tennessee. Michigan looks ıretty good on the other ear. We haven't ɩeard anything in the Pacific but when things pen up again it should be real good.

. . . W7CSD

Frank Firth W6QUD
Hank Olson W6GXN

The Parametric - Transistor Multiplier

In the past several years much interest has been displayed on the part of hams in the apparently magical device—the varactor—which has made BOTH parametric amplifiers and parametric multipliers possible. In this article the authors hope to show how rather ordinary transistors can apparently be made to operate as parametric multipliers, thereby opening the field to hams who might otherwise have left the "parametric" field alone.

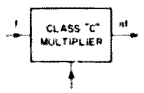


Fig. 1A

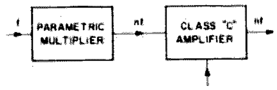


Fig. 1B

The class "C" multiplier has been the accepted amateur method of radio frequency multiplication for many years. The technique was developed around vacuum tubes and has been extrapolated into the transistor-multiplier technology, with similar results.

However, in recent years, the technique of parametric frequency multiplication using voltage-variable-capacitors has rapidly come into its own. In this technique, the power input is rf at the fundamental (instead of dc, primarily) and the parametric multiplier simply converts some percentage of that fundamenta frequency power to the desired harmonic fre quency. The efficiency of such devices, usin; modern silicon diode varactors, can be as higl as 80 per cent. The chief use of parametri multipliers has been in all-solid state powe sources at higher power levels and frequencie than available transistors will produce.

In addition, there are other types of fre quency multipliers utilizing the non-linea characteristics of various devices to generat harmonics. A familiar example of this sort o harmonic generator is the inexpensive germani um point contact diode used at the output o some 100 kc crystal calibrators to generate har monics of 100 kc throughout the hf bands, fo receiver calibration. Also, magnetic-materials with their non-linear hysteresis loops, are oc casionally used to produce harmonics. As a class, these harmonic generators are low effi ciency devices and are usually used only in cases where efficient multiplication is not the primary aim.

In this article we hope to show that hams can marry their old friend the class "C" amplifier to the newly-developed parametric multiplier to produce an improved and economically feasible multiplier.

According to Terman, the efficiency of the class "C" multiplier, relative to a class "C" am-

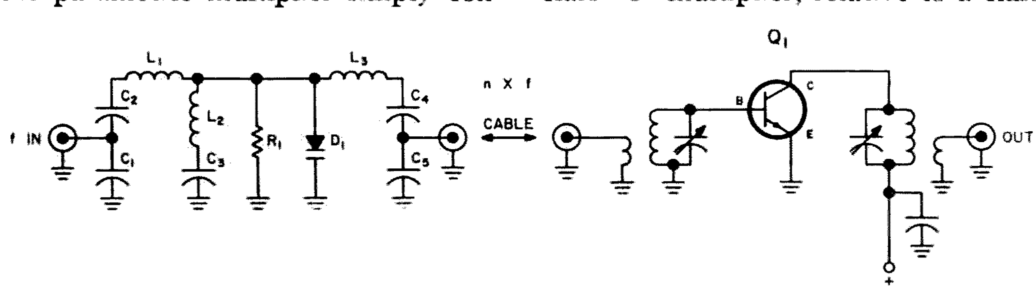


Fig. 2 Parametric multiplier and class C amplifier

TABLE 1

HARMONIC	OPTIMUM LENGTH OF SPACE CURRENT PULSE	APPROX. POWER OUTPUT RELATIVE TO CLASS "C"
2nd	90° to 120°	50% to 65%
3rd	80° to 120°	30% to 40%
4th	70° to 90°	25% to 30%
5th	60° to 72°	20% to 25%

lifier (a × 1 multiplier), falls off as shown ı Table 1.[1] These numbers assume that the onduction angle has been optimized as shown. 'hese efficiencies are relative and must be ıultiplied by the efficiency of a real class "C" mplifier. Taking 70 per cent as a figure for ıe collector efficiency of a good class "C" ·ansistor multiplier stage we get typical real fficiencies of some transistor multipliers as ıown in Table 2.

It might seem that, since the efficiency of a 1 class "C" stage is so much better than that f (say) a x4 class "C" stage, we could imrove overall performance by *parametrically* ıultiplying the drive x4, and then using an x1 lass "C" stage. If the x4 parametric multipliation can be made more efficient than the umbers in Table 1, we would gain some. 'his is shown in Figures 1a and 1b.

A typical parametric multiplier and a class C" amplifier could be connected as in Fig. by a low impedance line. However, by liminating the high to low and the low to igh impedance transformations between units, ıe transformation losses are eliminated, as ı Fig. 3.

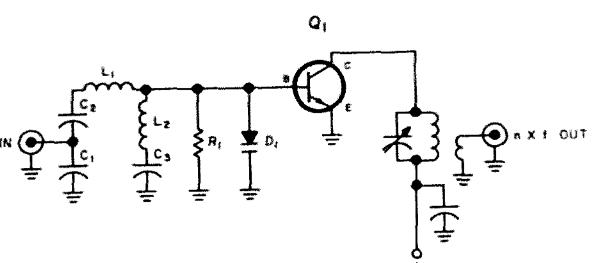


Fig. 3 Simplified multiplier-amplifier

Substituting the selectivity of the class "C" ollector tuned circuit for that of the deleted esonant transformations, we have the circuit ı Fig. 3 with the varactor and the emitterase diode of Q1 in parallel. So let's eliminate ıe varactor and use the emitter-base diode s our parametric element, and also use the est of Q1 as the class "C" amplifier. The ddition of L4-C6 is necessary to cause the irculation of x n currents in the base emitter ınction of Q1, previously caused by L3-C4-:5. (Both L4-C6 and L3-C4-C5 are seriesesonant circuits at the x n output frequency.)

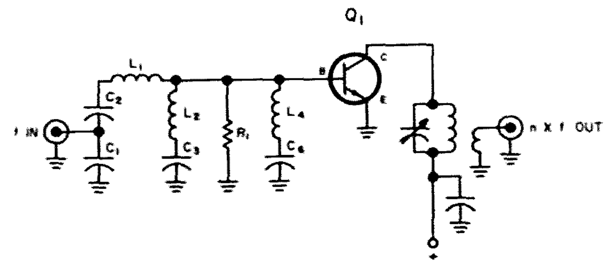


Fig. 4 Multiplier-class C amplifier using emitter-base of transistor as varactor

Such a system has several advantages over the other systems: no special varactors must be purchased, existing class "C" multipliers can be easily modified to this technique, improvements in load isolation over the simple parametric multiplier are achieved, and improvement in efficiency over the ordinary class "C" multiplier is obtained.

Several different circuits were tried in the hf range, using different multiplications and different frequencies. A 3.5 Mc to 14 Mc circuit was first constructed so that waveforms could be more easily observed with a 30 Mc bandwidth oscilloscope. As might be expected, our first choice for a parametric transistor multiplier was a silicon planar type transistor, since the silicon planar construction is also the way many varactors are made. A type 2N2951 was used to quadruple from 3.5 Mc to 14 Mc in the circuits of Figs. 5a and 5b. The circuit of Fig. 5a is the "control" circuit using the ordinary x4 class "C" technique, and Fig. 5b is the "experimental" circuit using the parametric transistor method. The collector efficiency of the circuit of Fig. 5a is 5 per cent and that of Fig. 5b is 24 per cent. Similar results with a type 2N1613 tripling from 7 Mc to 21 Mc confirm our relative efficiency measurements.

Both the circuit in Fig. 5a and that in Fig. 5b, were arranged so that both bias and collector impedance network could be adjusted

TABLE 2

HARMONIC	APPROX. EFFICIENCY
2nd	35% to 66%
3rd	21% to 28%
4th	17% to 21%
5th	14% to 17%

Fig. 5A

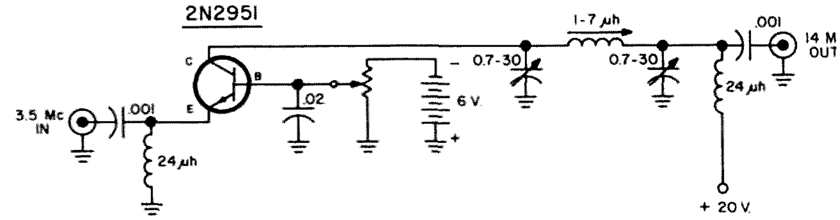
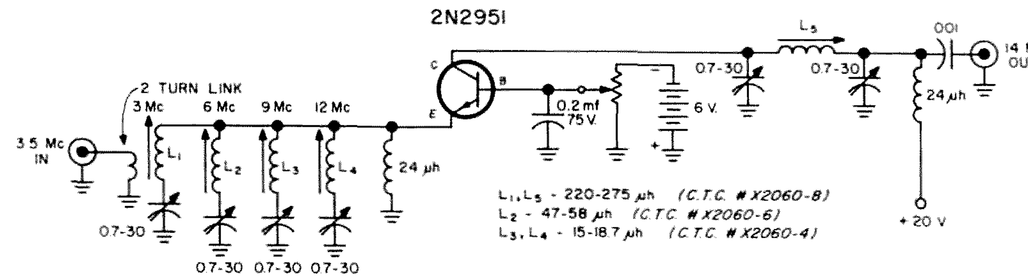
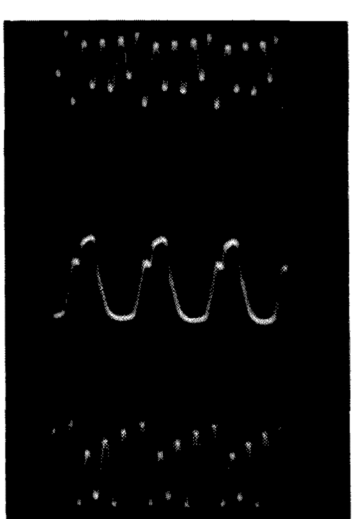


Fig. 5B



over wide ranges. This was done so as to be sure that the multiplication efficiency was optimized for each circuit. The input of the circuit of Fig. 5a was untuned, but provides a reasonably good match to a 50Ω generator. The input to the circuit of Fig. 5b was through a network, not to improve matching between the generator and the base of the transistor, but because it was the most convenient method-link coupling into one of the series-tuned idlers. The idlers themselves are of non-critical design, and in this case were made of comparatively low Q inductors (intrinsic Q's of 50 or less). The standard line of C.T.C. X2060-variable inductors were used in the frequency range specified by C.T.C. So long as any reasonable L to C ratio is held in each trap, it will work effectively at least to demonstrate the principle involved. The 24 μh R.F.C. in the emitter to ground position is simply for bias.



14 Mc output, parametric amplifier.

3.5 Mc drive.

14 Mc output, class C multiplier.

Fig. 6

One might think that the improvement in multiplication efficiency in the circuit of Fig 5b is due simply to improved input coupling efficiency and the effect that the 14 Mc series idler has in bypassing the emitter. However this is not felt to be the principal reason for multiplication efficiency improvement, because of the marked effect of the other idlers have on 14 Mc output, as they are tuned.

The observed waveforms are shown in Fig 6. The significant feature is the noticeable increase of "droop" between every fourth peak in the "C" output relative to the "parametric" output.

The use of one of the junctions of a transistor as a voltage-variable capacitor is not a new technique. Several workers have successfully used the base-emitter junction of various vhf transistors (even some germanium PNP types) as a parametric amplifier for low input noise.[3, 4] This leads us to believe that the technique described here may be applicable to nearly any junction type transistor. This would then open the way for improvement of many existing multipliers, by simple changes in biasing and addition of idlers.

The authors wish to thank Mauro Di-Dominico Sr. for his help, without which the working details presented here would not have been available.

. . . W6QUD, W6GXN

BIBLIOGRAPHY

1. Terman, F. E. "Electronic and Radio Engineering" 4th Ed. 1955, McGraw-Hill Publishing Co., p .475.

2. Zuleez, R. and Vodicka, V. W. "Transistor Operation Beyond Cut-off Frequency" Electronics, Aug. 1960, p. 56.

3. Zuleez, R. and Vodicka, V. W. "Parametric Amplification Properties in Transistors" Proc. IRE, Oct. 1960, p. 1785.

4. Lindmayer, J. and Wrigley, C. "On Parametric Amplification in Transistors" Proc. IRE, August 1961, p. 1335.

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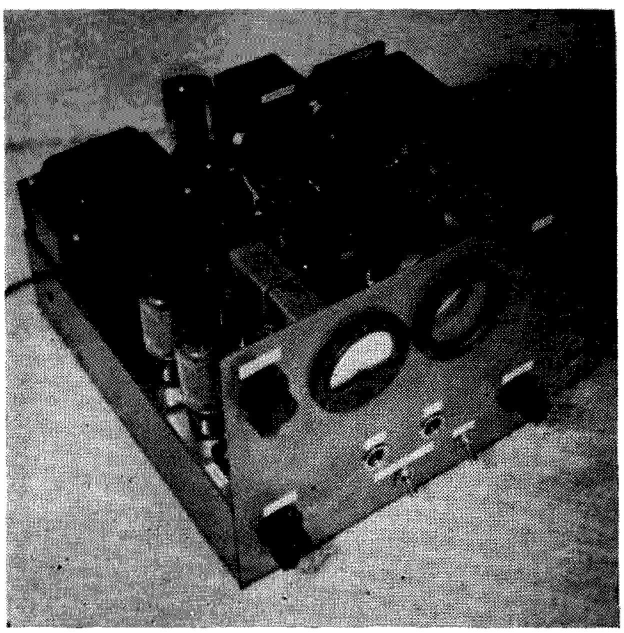
Improving the Garden City Terminal Unit



Improved TU.

Several improvements to the Garden City TU originally described in 73 Magazine (April '62) are described here. These include an adjustable mark-space filter, a wider range balance control, redesign of the limiter to favor the frequency response for normal tone frequencies, and a change of keyer tubes to increase the current capabilities, with provision for direct magnet keying, if desired. A 2" scope has been built into the unit, and a db meter provided to monitor the level of the teletype signals.

The Mark-Space filter was designed from information published in 73 Magazine (Nov. 1962, page 22). The mark filter which is tuned to 2950 cps, is a 3 section fixed filter. It has a bandwidth of approximately 120 cps. The space filter is a two section filter, variable for shifts of 170, 230, 550, 650, 750 and 850 cycles. The average bandwidth is approximately 85 cycles. Also incorporated with this filter is a "Broad-Sharp" switch to widen the bandwidth to approximately 200 cycles. The later feature was found desirable for signals which have a normal shift in excess of 850 cycles. I have also found an improvement in reception of certain signals which were in a bad state of selective fading, by switching to the broad position. Perhaps someone can shed some light on this phenomenon.

The balance control has been removed from the cathodes of the 12AT7 amplifier and placed at the input of the Mark-Space filter. A wider range of balance is obtained without lowering the cathode bias of the 12AT7.

Frequency response curves were run on the original limiter and low and behold I found that the gain was higher at 400 and 1000 cycles than it was at 2000-3000 cycles. I also determined that the second harmonic of 1000 cycles was down only 7 db below normal tones when the limiter was driven to 20 db of limiting.

Changing the plate coupling condensers reduced the response of the limiter at 1000 cycles by 5 db and at 1500 by 3 db. Final response curves of the limiter showed the second harmonic of the 1000 cycle tone—the worst offender—to be down 12 db in the output of the 6AL5 diode. Harmonics from 55 cycles were down 20 db. This all means that

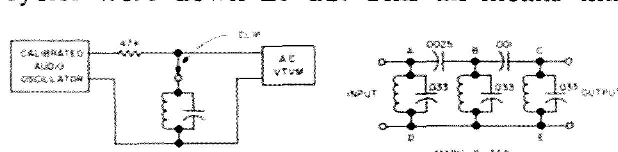


FIGURE 1

Construction of mark filter.

ou have increased interference rejection of iny signal which produces audio beats of approximately 550, 750, 1050 or 1500 cycles. The Sharp filter will reject these latter tones by 40 db or more, but we still have to contend with their harmonics developed within our own limiter.

6L6 tubes were used in the keyer circuits so that the selector magnet could be operated directly. To convert to 60 ma operation it was only necessary to reduce the 1000 ohm common cathode resistor to 500 ohms and increase the screen voltage until the desired 60 ma was obtained in the selector magnet.

The 2" scope is built around a 902P-1 tube. A separate 12AX7 amplifier is used for the scope. One reason for this amplifier is to avoid overdriving the 12AT7 signal amplifier, which in turn would cause more harmonic voltage at the 6AL5 output. The scope circuits are simple and should not discourage anyone from building it. With a sharp filter the scope is a necessity.

Notice in the power supply that 3 rectifiers are used: a 5U4 with choke input to provide 210 v with good regulation for the audio and keyer circuits; a 6X4 with condenser input to provide 350 volts for the plate of the 902P-1; and a 1N70 bias supply on the scope for controlling brilliance. Since little or no current is drawn, any small diode is suitable for this. Notice the 330 k and 100 k resistor network from the power transformer to ground. This is a voltage divider and limits the ac voltage on the 1N70 to 75 volts. Due to the extremely low current this bias voltage is easily filtered with two .047 mfd condensers and a 2.2 megohm resistor. The bias voltage is continuously adjustable from 0-25 volts by means of the 4 megohm potentiometer.

Construction of the Mark Filter

Before starting to build this filter I suggest you read the very fine article in 73 Magazine for Nov. 1962, by W3TUZ. For this filter I unwound discarded 210a telephone repeat coils. However regular 88mh coils could be used and less time consumed in the construction. You must first determine the size and select the coupling condensers to be used, as these are part of the frequency determining components. In this filter I used a .0025 mfd and a .001 mfd coupling condenser. The toroids were shunted with .033 mfd condensers. Since this is an exacting procedure, each condenser to be used in the filter must be used in the exact position while tuning procedures are being carried on. I suggest that all the

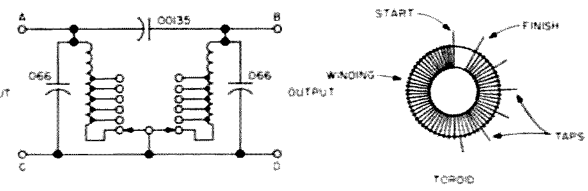


FIGURE 2
Variable space filter.

coils and condensers be mounted on a terminal board before tuning is started.

Tune these toroids to 2950 cycles for the Mark frequency. First short B to D. This places the .0025 coupling condenser across the "A" section coil in parallel with .033 mfd. Now check the frequency and start removing turns until Coil "A" tunes to exactly 2950. After the first coil is tuned, remove the previous short and place a short from A to D and from C to E. This places both the .0025 mfd and the .001 mfd condensers across the "B" coil. Tune the "B" coil to 2950 as above by removing turns. Now remove both previous shorts and place a short from B to E. This places the .001 mfd condenser across the "C" coil. Again tune by removing turns. Now if you are interested you can feed the audio oscillator in at A and D in series with a 47k resistor and place a 100k load and VTVM across the output. The resonance curve will be very sharp. You can check the bandwidth at the 3 db point by varying either side of center frequency to a point where you obtain .707 of the maximum developed voltage. The difference in the two audio frequencies is the bandwidth. It should be around 120 cycles. If this filter is reversed end for end it will be broader: around 200 cycles.

Construction of the Variable Space Filter

The space filter toroids were hand wound from discarded 210a telephone repeat coils. Other toroids could have been used but the ¾" inside diameter of these cores make them ideal to rewind, using a TV horizontal Osc coil as the source of wire. It is only necessary to clamp the core between a couple of boards and start passing the TV coil through the hole in the center. Always pass from top to bottom. This may sound tedious but really it is not as bad as it sounds. It goes quite fast. Count up to 100 turns and put a mark on a piece of paper and count again up to 100. With very little practice you can put on 30 turns or more a minute. Try to keep the winding fairly smooth; however, this is not an absolute necessity. I have unwound several different commercial toroids and they are not wound very smoothly either. Start by winding a single layer to the right—along the core—until you

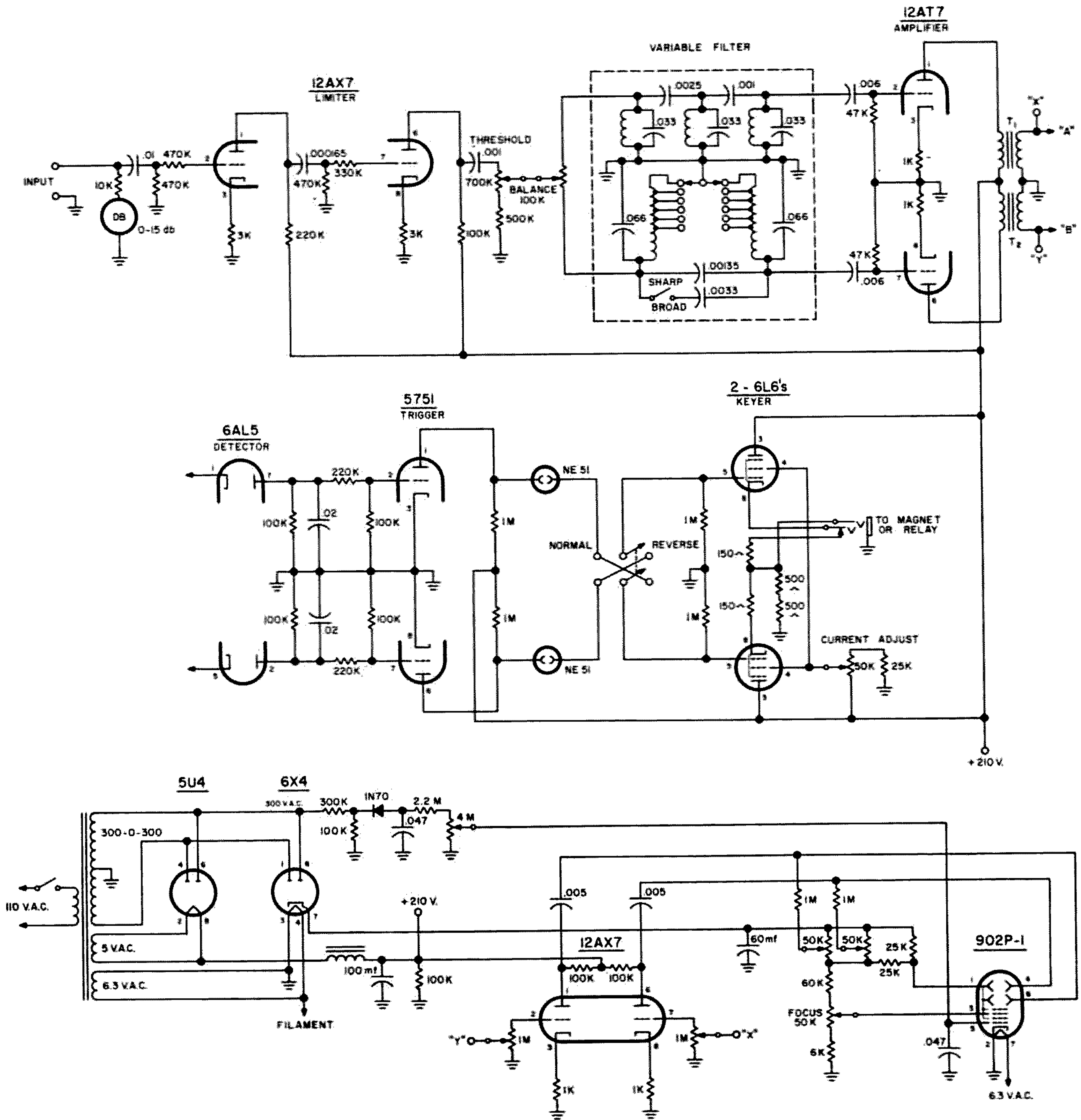


FIGURE 3

have gone half way around the core. Then wind back over your original winding to the left. The wire is always dropped through from the top so that the winding around the core is always in the same direction. Add layers winding back and forth until you have wound on about 800 turns. You should now have slightly in excess of 80mh. All of this winding will be on half of the core. You are going to use the other half for making taps. Since the taps require some tape for binding, more space will be used up. Select good quality .066 mfd condensers with which to tune these toroids. You must first determine the bandwidth you desire. This is determined by the size of the coupling condenser. I used a .00135 coupling condenser (actually tw .0027 in series). Refer to Fig. 2. Mount the first coil to be tuned and the .066 mfd condenser which will tune it, on the terminal board which will comprise the space filter. Shunt the .00135 condenser across the coil and condenser combination. Connect the audio oscillator and VTVM as with the mark filter an check the frequency. For 170 cps shift this will have to tune to 2780 cps. If necessary remove turns until this coil is tuned to 2780 cps. Make a tap by joining on to the TV coi again and add about an 8" length of colore wire which will later connect to the switc

'ape the splice and fasten to the core of the ›roid with either plastic or masking tape.

Wind about 30 turns of wire on the un- 'ound portion of the toroid core. Check the ·equency again, and remove turns if neces- ıry until the coil tunes to 2720 cps (230 cps ıift). Again make a splice and bring out a ifferent colored wire for the switch. The next ·equency gap is greater so you must wind on bout 125 turns or better, 150 to be sure, and heck the frequency again. This time tune ›r 2400 cps (550 cps shift). Again add turns nd taps and tune for 2300, 2200, and 2100 ɔs. Use different colored wires for each tap › readily identify them when permanent wir- ıg is made to the switch. This coil will now e tunable for shifts of 170, 230, 550, 650, 50 and 850 cycles.

Wind the second coil in the same manner. e sure to use the same .00135 coupling con- enser in shunt with the second coil and .066 ıfd condenser. Make sure you use the .066 ıfd which will be permanently used in the ːrcuit. Using the same color wires for taps ; you did with the first coil will make it ısier to wire up the switch. The switch is a x position, two pole Mallory 3226J. Mount ıe two filters in a 5 × 7 aluminum chassis ːong with the switch and complete the wir- ıg to the switch.

The variable space filter could have been ıade from fixed coils using the switch to ıunt in different size condensers to tune the ›ils. I believe this would take a large supply ː condensers in order to match condensers › exactly the same capacity, as the most com- ıonly used condensers on the market appear › be 10% or more tolerance.This is why I referred to make taps.

Miscellaneous Construction Notes

The face of the 902P-1 is mounted in an d 2″ meter case. Mount back about an inch › help keep the room lights off of the face ː the scope tube. In order to keep the system alanced all the way through, the grid re- stors on the 12AT7 amplifier should be ıatched. Also the following: the 100k load ·sistors on the 6AL5; the 220k filter resist- ːs; the 100k grid and the 1 meg plate re- stors on the 5751 trigger tube. These can be ısily matched within 2% with an ordinary ımeter.

No doubt someone will wonder how we ın space 85 cycle filters with their centers ͻ0 cycles apart. Notice that the mark filter 120 cycles wide. Shifting the receiver tun- ıg slightly across the mark filter will allow ͻ0% coverage.

. . . W7CJB

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An Orbit Computer for Oscar III

To paraphrase a famous recipe for rabbit stew, to communicate through OSCAR III, first find it. The orbit computer described here will help you do just that.

The materials required for this computer are easily obtained—a 10- or 12-inch globe of the world, a piece of stiff wire, some tape, and a grease pencil.

To make the computer, proceed as follows. Draw a great circle around the globe, passing through 0- and 180-degrees longitude at the equator. The angle formed between the plane of the great circle and the plane of the equator should equal the inclination of the OSCAR III orbit. Divide this great circle into nine equal segments representing 10-minute intervals in a 90-minute orbit period.

Draw in the subsatellite track, the imaginary line on the earth's surface directly below the satellite. Starting at 0-degrees longitude on the equator, move north to the first 10-minute interval marker on the great circle and place a small mark on the globe 2.5 degrees west of the marker on the great circle. At the 20-minute marker, move west 5 degrees and place a small mark on the globe. Continue placing small marks on the globe due west of the 10-minute markers on the great circle, with each small mark being 2.5 degrees farther west than the preceding one. Be careful to place these small marks DUE WEST of the great circle marks and not on a line at right angles to the great circle.

Connect these marks with a line. For a 90-minute period, the subsatellite track should return to the equator after one orbit at a point 22.5 degrees west of the 0-degrees longitude line. If the OSCAR III period should be closer to 100 minutes, ten 10-minute intervals would be marked off on the great circle, and the subsatellite track would return to the equator 25 degrees west of the 0-degrees longitude line.

Bend the piece of stiff wire into a circle slightly larger in diameter than your globe. Separate the wire ends so that they lie on the ends of the subsatellite track, and bend the wire where necessary to make it agree with the subsatellite track all the way around the globe. Fasten the wire to the globe support ring, but leave the globe free to turn under the wire. When the wire is in place, transfer the 10-minute interval markers to the wire and add 5-minute markers between them.

This orbit predictor is not absolutely accurate, since few satellites have exact 90-minute periods. However, it is close enough to give a tracking station operator a good feel for the location of a satellite during a given orbit. In order to obtain the best results, the inclination error should be less than 2 degrees; the error in longitude advance should be less than 1 degree; and the error in period should be less than 2 minutes. If care is taken in constructing the computer, these tolerances can be met easily.

Orbital predictions containing the data needed to make the computer work will be given in regular Project OSCAR bulletin transmissions from W1AW and W6EE. W6EE is the Project OSCAR headquarters station; it will operate on 3507.5 kc, 7015 kc, and 14030 kc using CW and RTTY. Bulletins will also be broadcast on SSB; the frequencies will be announced during the CW and RTTY bulletin transmissions.

To locate OSCAR III at any time during an orbit, set the beginning of the wire over the point on the equator where the predictions say the orbit crossed most recently. Then measure along the time marks on the wire to locate the satellite at the moment in which you are interested.

This is a crude device, but it is also quick and efficient. With it you should have no trouble locating OSCAR III.

. . . W7MC/6, W6HEK

Charles Pirolo
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Sussex, Wisconsin

Cartoons by Wayne Pierce K3SUK

The Ham

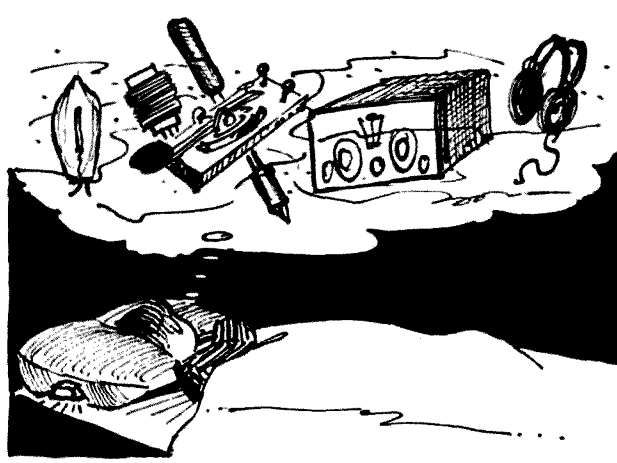
The road to becoming a Ham is as exciting as the road to stardom

It is hard for me to remember when I first wanted to be a ham. I never wanted to be anything else but a ham.

I was born June 1, 1928, in Minneapolis, Minnesota. I have a younger brother, Delbert, who lives a conventional life in California teaching exceptional children. My older sister, Dolores, is happily married and has thirteen children. My mother was a beautiful woman who loved to cook Sauerkraut mit Schweinekotletten, a German dish of sauerkraut and pork hocks. My father never understood me and left home when I was sixteen. I never saw him again.

My life was a complete waste until I was in the fourth grade. I was a small, fat kid whom nobody loved and everybody teased. I never played with the other kids at recess. To fill my lonely hours I read Boy Electrician and dreamed of becoming a ham.

I spent my lonely hours reading the Boy Electrician . . .



I slept on the bar of solder and dreamed of becoming a ham . . .

Miss Ludwig, my fourth grade teacher, saw a ham under all my fat. She liked me. One day she gave me a two pound bar of solder. She said it would help me become a ham. I carried it everywhere I went. I enjoyed flipping and spinning it in my hand. I loved its smell and smooth texture. It was then I discovered I commanded everybody's respect when I carried it clutched in my fist. At night I would sleep with it under my pillow, and dream of becoming a ham. I never lost that dream.

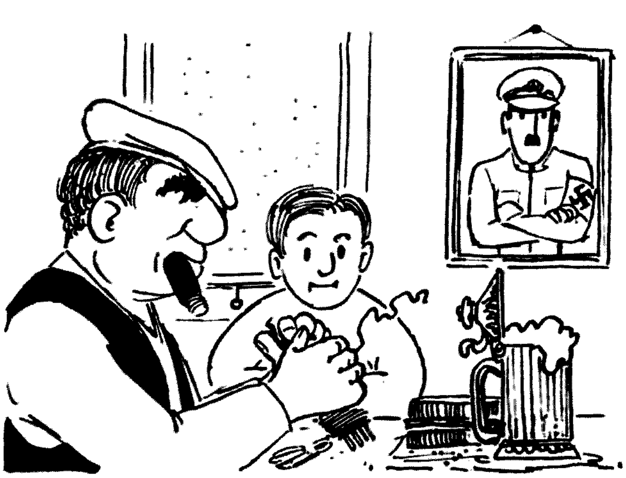
When I was eleven we moved to a large apartment building in Cincinnati. This was to be another turning point in my life. It was in this apartment building I met Joe Schultz. He gave me my first real start. I remember Joe. He slept late every morning because he would CQ late into the night. I ran errands for him to the delicatessen. He loved dark sour rye bread, hard salami and beer. In return, he gave me the privilege of watching

him work. It was a great time for a boy to be alive.

I fell under the spell of Joe Schultz. I can still see him wrapping a transmitting coil, his cap pulled down to his heavy eyebrows and a huge black cigar hanging in the corner of his mouth. He was the kind of ham that few younger men have the privilege of seeing today. He built his own rig up from nothing. This is the sort of thing you don't find among today's hams. They've gone commercial.

Joe worked hard. His entire apartment was his shack. Joe never kept a junk box—there was a place and purpose for every goody. No fancy soldering gun or rosin core solder for Joe. Just a good old three pound soldering iron heated on the gas stove. Joe loved to work in the dark and he always kept the shades drawn. On the wall was large photograph of a thin man with a little mustache and piercing black eyes. His arms were folded; he wore a kind of band on his left arm with a crooked indian cross on it. Joe would look up at the picture and would tenderly put his hand on my head. "Ja, you would do vell in der Jungvolk."

The hours I spent with Joe were the only really happy hours of my life. I watched and listened—a small, fat kid among a giant. I soaked up the smell, the sight, and the sounds. It was here I learned the basic essentials of being a ham. Hams aren't born. It isn't something you can inherit. You can't learn it from a book. Being a ham is an instinct, something that blossoms from within. Then came that crazy day when Joe told me I had a ham's instinct. My head swirled and I felt in my heart I was destined by fate to become a ham. Never for a moment have I lost that feeling.



While neighbor Joe Schultz wound a transmitter coil, I watched enraptured . . .

Father reported Joe to the FBI . . .

My life has been filled with tragedy. I remember the day I told my father I was going to be a ham like Joe Schultz. He flew into a rage. Hams like Joe were looked down upon in those days. People, especially my father, had no use for them. Father shouted that this whole thing had gone far enough. he was going to stop me. But he couldn't destroy the dream.

Yes, there was tragedy. Father reported Joe to the FBI. I remember the day when I came home from school and found Joe's apartment door open. His transmitter, power supply, and key were gone. I cried. Joe was gone! The apartment was a mess with *Radio* magazines scattered over the floor. They were something nobody wanted. I remember the strange chill when I found Joe's soldering iron under an old *Radio*. I have never used it. I carry it with me even today. Each time I look at it, I recall those happy days—the dahdit didit didahdidit's, the anticipation, the warm glow of the parallel TZ-40's, the smell of the sal ammoniac block—those were the days!

I suppose becoming a ham is largely a matter of getting the breaks, and I've had my share of them. I remember my first big break came when I was in the eighth grade. I was chosen to construct a transmitter for our science demonstration. I had just two days to solder my spark coil, capacitors, and key. It was either sink or swim.

I remember the night of the science demonstration. All the parents were there. Mother was so proud. They were fascinated with the way my rig arced. Even the government sent two men just to inspect my work. I told them

I built it myself. Hand craftsmanship! You don't see much of that anymore.

That night father flew into one of his rages about my becoming a ham. He told me I had to stop. But nothing could stop me from doing what I knew deep down I had to do. I was going to get a license no matter what.

Mother understood and stood beside me. She read the letter the men from the government gave father. Her eyes misted over. She squeezed my arm but never said a word. I knew then it would be all right. She and father fought late into the night. When the shouting stopped, I knew he had packed his bag and left home again.

When I was in high school, I build my first sustained arc transmitter. It was during those years I developed and polished my code style. I read *Radio* until it soaked into my pores. Those were the heady years when I learned didah to dahdahdidit. Becoming a ham is not so much in the knowing, but in the feeling. When I was eighteen, I almost got my first license. My feet never touched the ground.

I was studying for my first license when I married my first wife, Susan Maycomb. We had a daughter, Betsy, who could tell a resistor from a capacitor by the age of three. Susan was a pretty girl with flashing dark-brown eyes. In-law problems ended our marriage. Her father was strictly SSB.

My second wife, Mabel, talked me into taking a regular job with a large company. The pay was great, but I knew something was wrong. The parts I soldered had the dreary sameness about them. I was just repeating myself. I could tell from the cold solder joints I had gone stale. The company said if it was the air I wanted, they would give it to me. I was free again and my second wife left me several weeks later. I learned you can't be a ham and have a job and a wife at the same time. This is the mistake so many younger men make. They divide their interests.

I went back to live with mother. She was the only one who understood what it means to be a ham. She understood when I turned the living room into my shack. Some people were critical because my mother supported me during my early years. But I never flinched once; I knew she could do it. Good old mother—she gave me quite a start the day she grabbed my open transmission lines. She understood when I explained enclosed lines don't radiate freely.

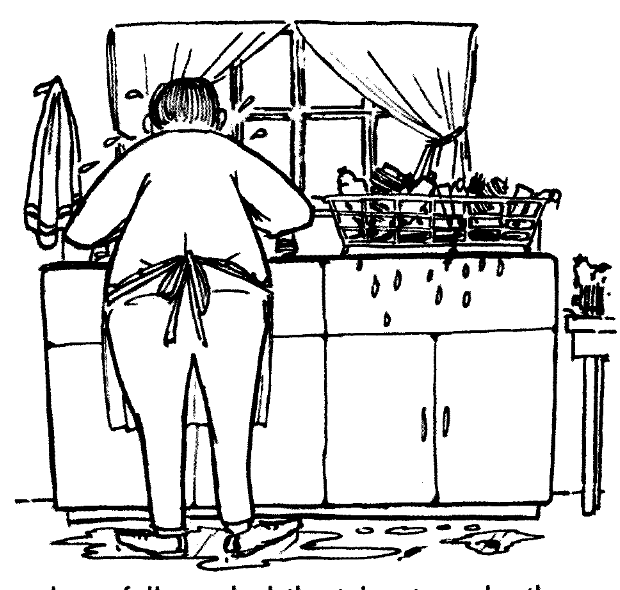
My first rig went west, but I didn't mind. I was a full time ham again. But something was wrong. I blew too many jugs. I was searching to find myself. Nothing seemed to click. I felt I was finished.

Then it happened. I was almost asleep one night when the words thundered into my sleepy brain. "Build what you know." That was it! I dragged myself out of bed and started to build my first modulated high frequency arc transmitter. It was wonderful.

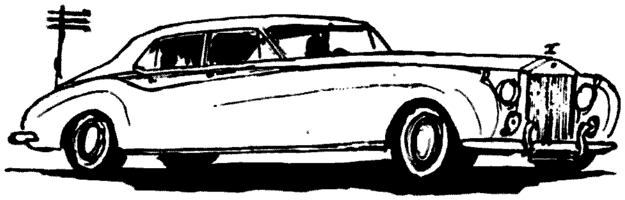
The morning began to break for me. Instead of fumbling with narrow band transmitters, I built broad-band rigs. I saw transmitters as a whole, not just parts. Little by little I learned *System* hamming. If something wouldn't click I would relax and let it simmer. Slowly the answers would come from the depths of my being. A warm glow inside would give me a sense of satisfaction and everything seemed to build itself.

This was the way it was with my first rig and this was the way it was with every rig since. To this day I can never start a rig without a sense of tremendous pressure. I become keyed, tensed, modulated, nervous, suppressed, impatient. I swear, smash a vase or break a window. Every nerve is raw, open and waiting for inspiration. This is the time a rig arranges and rearranges itself in my mind. Then it clicks, and I sit down and build. I become relaxed when I work, but the sense of responsibility remains.

When I became older, I realized there were other hams—young, struggling—less fortunate than I. I dedicated myself to helping them. I borrowed a thousand dollars from my mother and invested in surplus equipment. I carefully washed the jugs and bottles and beautifully relabeled them to make them easier to read. I reconditioned thousands of parts. I introduced them into the hungry ham market. Success was immediate and I was able to retire after two years. I retired with a deep satis-



I carefully washed the tubes to make them easier to read . . .



Success brought a Rolls Royce . . .

action that I had helped many young hams ;et their start.

We hams are a strange breed. On the sur- ace we appear to be ordinary people. We augh, drink, and dabble in the banal pleasures of the world. But underneath this false exterior there is a deep sense of humility.

Striving to become a ham has given me some of the material pleasures of life—a fishing retreat in Wisconsin, a hunting lodge in Canada, (mother likes to hunt and fish), a Rolls-Royce and so forth. But these are not important. Building a rig is all that matters to me. It's the soaring ecstasy, the flying to dizzy heights, the tingling of every nerve. To this day I can never go anywhere without Joe's three pound soldering iron. It reminds me of what I was and from what depths I climbed.

. . . Pirolo

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Fleet Sonar School
Key West, Fla.

Improving SSB Performance of the SX101

SSB reception can be improved immeasur- ıbly by the addition of a product detector in ıny of the SX101 series receivers which have ›nly a diode detector.

Referring to Fig. I and the receiver sche- natic, this is a step by step way to do it. No holes must be drilled and the receiver nay be returned to its original condition in ıbout a half hour.

First, build the circuit in Fig. 1 on a 7 pin niniature Vector socket, mounting all com- ›onents on the socket extension. Mount the Vector socket on a small L-shaped piece of ıluminum and secure to the side of the chassis with one of the bolts holding the side brace. Remove S5 and replace with a spdt toggle ;witch. Solder together the two wires removed rom old S5, and tape. Make connections to ilament and B plus. (B plus connects to C87B). Remove bfo lead from pin 1 of V7 and connect through a shielded lead to pin 1 of the product detector. Connect a shielded lead from pins 2 and 9 of V7 to pin 7 of the product detector through the 5pf capacitor. Do not disconnect any leads from pins 2 and 9 of V7; the output from the last *if* is fed to both the diode detector and the product detector at the same time. Connect the center of new S5 through a shielded wire to the side of C89 that goes to S2A. Disconnect at S2A the shielded lead coming from pin 6 of V7 and reconnect to the upper end of new S5. Connect a shielded lead from the bottom pin of new S5 to pin 5 of the product detector. This completes the construction. The only thing left is to recalibrate the bfo. This is done by removing the knob and adjusting the shaft (L16) to a point where the carrier of an AM signal will remain at Zero Beat when switching from uppr to lower sideband. The knob is then reinstalled with zero at the marker.

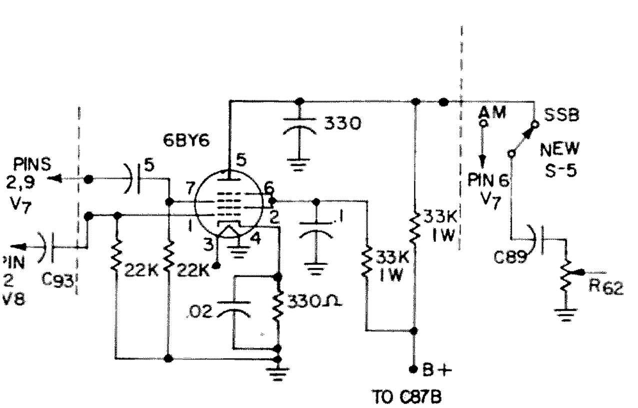


FIG. I

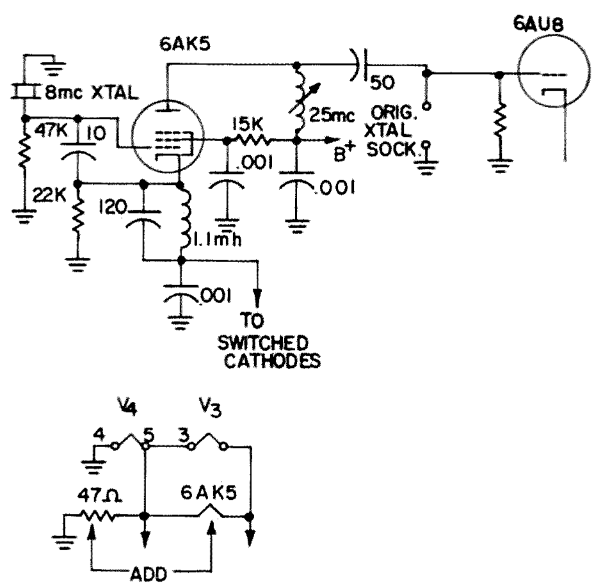
You may have noticed that the bfo is left on at all times. This has absolutely no effect on the AM operation of the receiver. You will also notice that the gain may now be kept much lower on SSB, the SSB signals will be cleaner and sharper, and the 1kc position may now be used for SSB reception. The bfo no longer affects the S meter; it will read zero on SSB & CW in the absence of signals and noise. Dig in and have fun; you don't really need a new receiver.

Converting The Heath CB-1 To Six Meters

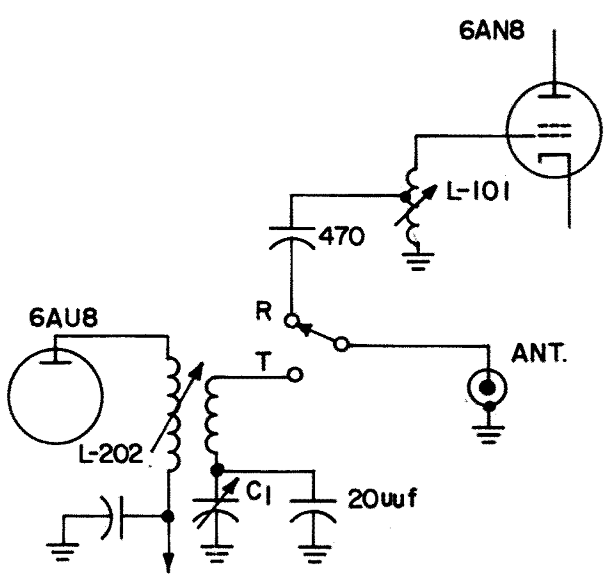
Larry Levy WA2INM

Because of the crowded conditions on the 11 meter band, it is almost impossible in this area to use a receiver that has a regenerative detector. For this reason Heathkit CB-1 transceivers are becoming available quite reasonably. These units have a lot more life left in them since, with a little conversion, they make wonderful mobile and low power fixed six meter stations. The receivers are extremely sensitive, are insensitive to ignition or similar noises, and selectivity is fine for most mobile operation.

The conversion is simple. Remove the 12 mmfd condensers that are across each of the four coils. Remove four turns from each of the coils. Remove the 2.2 mmfd condenser between the t-r switch and the antenna coil. Tap the coil 1½ turns from the cold end and connect a 470 mmfd condenser between the tap and the t-r switch. Remove the coil from the trap and connect the antenna lead directly from the jack to the switch. Break the lead from the grounded side of the link and connect to one side of trap trimmer. Connect the other side of the trap trimmer to ground. The trimmer will work as a loading control (see Fig. 1). The basic conversion is now complete. Insert a 50 mc third overtone crystal in the crystal socket, tune up the transmitter and receiver, and you are on the air.



8 mc conversion.



Conversion to 6 meters.

For those who would like to use 8 mc crystals, it is necessary to add another tube to the rig. The circuit is shown in Fig. 2. To use the extra tube on battery operation it is necessary to add a 47 ohm 5w resistor to balance the currents in the heater circuit. The tuning is the same as a standard transceiver except there is an extra coil to tune. There are also several other improvements that can be made (front panel tuning, etc.). For details of these see "Modifying The Lafayette HE-35," 73 Magazine, Feb. 1962, p. 54. Some of the HE-35 modifications can be adapted to the CB-1 (now converted to Heathkit Sixer). For a few dollars and about an hour's work, you can have a rig that will equal many of the more expensive transceivers in performance.

. . . WA2INM

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Fayetteville, Tenn.

An inexpensive GG 813 Linear.

The Big Bang

In the era "BGS"*, the art of ham radio was rather simple. Perhaps it was even crude compared to modern modes of communications. If you wanted to transmitt, you had to hunt for materials you hoped you could make the parts that would give you the results you were looking for. In other words, if you could not make the parts, you were not on the air. When a project was completed, it looked like something that should not happen to wire, tin cans, tin foil, copper tubing; but it worked!

For my money, one of the big thrills of ham radio is just about to fade away—to sit down and figure out a circuit, design the rig, give it the old smoke test, kill all the bugs, keep your neighbors on speaking terms, call CQ, and have someone come back with a big fat 5X9!

Then came the era "AGS"*. With a bit of time on my hands and drifting back to the dark ages, I thought I would like to see what would happen if I tried to figure out a simple linear using as few parts as possible.

So I sat down and came up with the circuit shown—keeping in mind we have to live under FCC regulations, a few simple electronics rules, and the fact these rigs can kill you quicker than you can give a break-break.

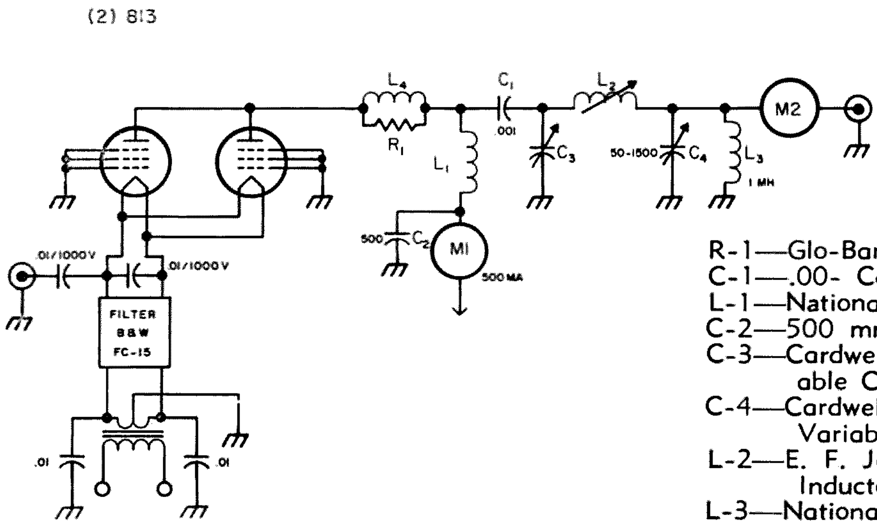
After a few smoke runs, I decided that all I had in mind could be put in a cabinet 12″ × 12″ × 12″. A pair of 813's was the choice; they are rugged, tough, and still on the surplus market at reasonable prices. They do not require forced air.

I took the sketch in hand and went to the local welding shop. In no time at all the frame was constructed from ½″ angle iron. Corners were spot welded, and a flat piece of the same material was welded 3½″ from the bottom of the frame to the top of the cross piece. This was necessary to allow the flat deck aluminum plate to be held in place. The flat deck plate was cut to allow the piece to fit snug inside the frame, even with the outside of the frame, making a good rf shield to the parts placed below the deck.

The front panel was cut 12½″ × 12½″, which allows a ¼″ edge around the cabinet. When placed on rubber feet this gives some protection to the side walls.

One of the photographs shows the underside of the flat deck plate, the trimmed corners, the two 813 sockets, the filament transformer, the B&W FC-15 choke (I might add, this is a must to avoid headaches), the high voltage feed-through insulator, the four .01 by-pass

* "BGS"—Before Goodie Stores.
** "AGS"—After Goodie Stores.



R-1—Glo-Bar-Fr-051 6 Turn #14 wire
C-1—.00- Centralab-858-5 H1-K
L-1—National R. 175-A platechoke
C-2—500 mmfd. door knob capacitor
C-3—Cardwell pl-8048 20/220 mmf Variable Condenser
C-4—Cardwell pl-8013 50/1500 mmf Variable Condenser
L-2—E. F. Johnson #229-202-2 Variable Inductor
L-3—National-R-300-1 mh. chore R.F.

capacitors—two at the hot end of the 10-volt filament, one from the BNC connector, and one across the filaments. The 813 sockets were wired as shown. The pins, except filaments, were grounded under the 8/32″ pan head screw.

The back wall was made from aluminum held in place with aluminum 90° angle. A five pin socket was used to the common ground and the incoming 115 volts ac. The Johnson feed-through insulator is shown to the right side with shielded high tension wire.

The top of the flat deck shows the placement of parts: the two 813's, the NAT R-175A plate choke with the 500 mmfd door knob by-pass, the top of the high voltage feed-through insulator, the globar parasitic choke, the blocking condenser with copper straps in place, and the two wires for the 500 ma meter.

There are a few comments regarding the back side of the front panel. The Johnson 229-202 is mounted on a small sub-bracket secured to the front panel by a piece of ¾″ × ¾″ aluminum held in place by 6/32″ flat-head screw in a counter sunk hole.

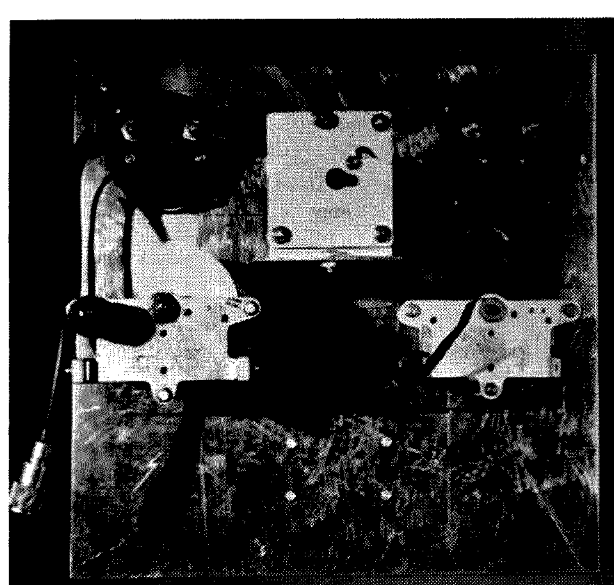
The variable inductor is placed on its bracket to allow ½″ clear of the front panel and ¼″ bearing connector. The rotor must be insulated from the ground. The copper strap shown on the plate tuning condenser and the strap on the right side of the variable inductor, go to the top of the blocking condenser secured by a pan head 6/32″ screw. A short piece of copper strap is soldered to the other end of the inductor and then to the roller of the inductor.

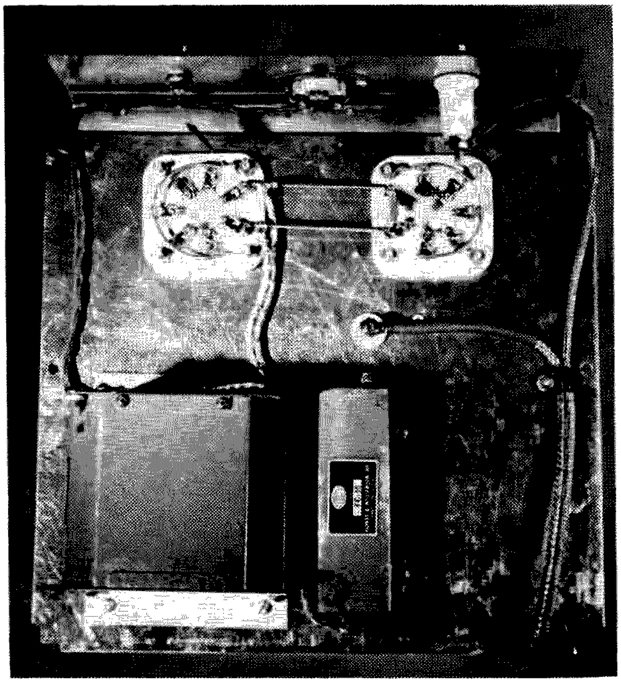
The antenna tuming condenser on the left is wired as follows: The roller of the inductor and the stator are connected to one side of the 0-5 rf meter. A word of warning: Do NOT tune this rig with high voltage applied unless it is connected to the antenna or a good dummy load. A light bulb is not a good dummy load. Should you try to load up without a proper load you will blow this meter out.

The output of the rig is carried to the Amphenol bulk head feed-through by the short piece of RG8/U secured to the rf meter. The braid is grounded under one of the meter screws.

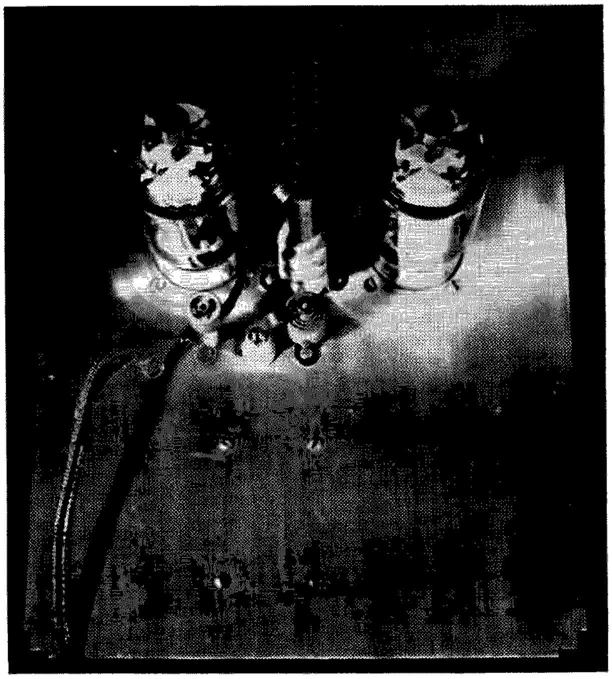
The 1-mh rf choke shown on the left side of the antenna tuning condenser is connected to the stator side of the condenser to a ground on the condenser. Don't forget this one, or you might be sorry.

The back of the rig should not need many


Back of front panel.



Bottom view.



Top view without panel.

words. To the left top is the Amphenol antenna connector; on the lower right bottom is the grounding lug. Left to right: The BNC input from exciter, 5 pin socket, ground between power supply and rig, the 115 volts ac, bottom pin NC, two top pin ac coltage, and pins below are ground.

The frame is enclosed by perforated aluminum secured by tapped 6/32″ pan headed ¼″ screws.

Operating the rig is very simple. If you wish to raise freuency, you turn the spinner knob to the right. To lower the frequency, turn spinner knob to the left.

The front view shows a white dot on the plate and antenna condensers. When the two dots are at 12 o'clock, the two condensers are at low C, or the stators are in full mesh.

An incoming signal from the exciter will produce a reading on the plate meter. Say the signal from the exciter is at 3900 kc. You don't know where the variable inductor is positioned. Suppose it is in the middle of the coil. Turn spinner knob to the left until the plate meter starts to fall. By the use of the plate tuning condenser and the variable inductor you should find a point of resonance of approximately 10 to 15 mils on the 0-500 plate meter. At this point, leave the inductor as is. By the use of the plate tuning condenser and the antenna tuning condenser, you should be able to load the rig to 450 mills, or above.

Remember every time you change the setting of the antenna tuning condenser, you upset resonance, so re-dip the plate tuning condenser.

Static current for the two 813's, with the following voltages, should be (approximately):

1500 volts	30 ma
2000 volts	35 ma
2500 volts	40 ma
3000 volts	60 ma

The "watts per dollar dc carrier" of this little rig as shown, using parts listed and voltage and current as indicated, should be approximately one-third the cost of the standard linear amplifiers—2000 watt PEP ratings—being sold at current amateur net prices. Of course, this does not include the power supply which is not shown.

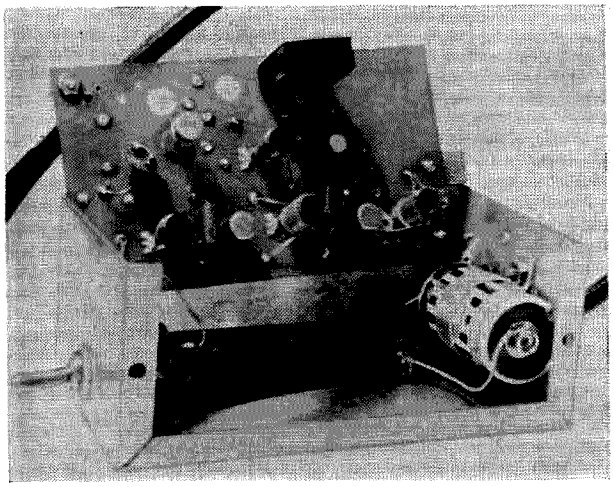
Any supply rated at 2000 to 3000 volts dc, with a current rating of 500 ma should keep you home free at all times.

The supply used here is a two section brute force filter, having a three tapped primary, giving a secondary output voltage of 2000-2500-2850 volts ac. The rectifiers are 3B28's. Any handbook will show this supply and components.

Summary

My QTH is far from ideal. Channels 4, 5 and 8 are approximately 75 miles air line; channel 3 is approximately 125 miles. So TVI is important. Thus far the neighbors speak, even pet my bull dog. Phone doesn't ring, and that's nice. Small town. I like it, and I don't want to move. I might mention that the local TV cable tower is within 500 yards air line on a high hill. Turning my beam on same, running legal limits on twenty, fifteen and ten—no reports from anyone.

. . . W4BV



Edward Pagel WAØHQA
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Denver, Colorado

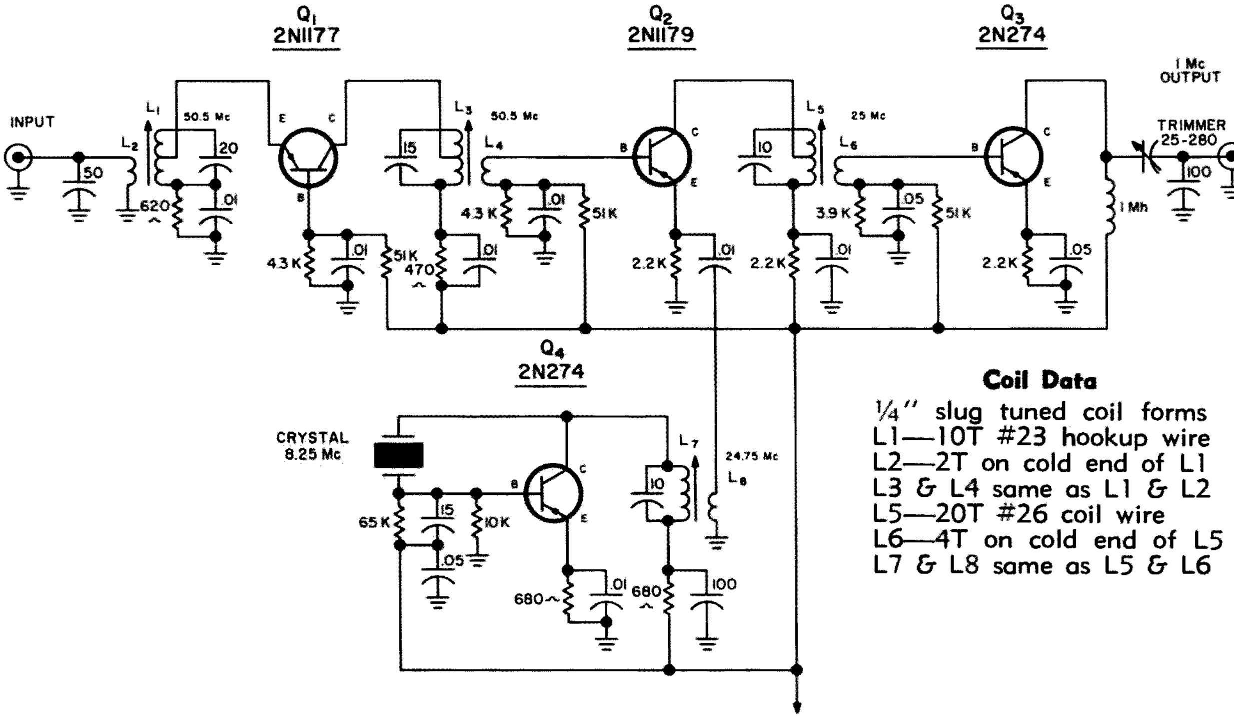
A Better Converter

At first glance, this converter looks like an ordinary single conversion converter. But the final stage is not an amplifier but a second mixer. The input coil to the last stage is tuned to a nominal frequency of 25 megacycles. There are two frequencies present in this coil: the first *if*, 25.75 mc, (50.5 mc minus the oscillator frequency of 24.75 mc) and the oscillator frequency, 24.75 mc, itself which is used twice. Q3, the second mixer, has an output circuit tuned to 1 mc (25.75 minus 24.75 equals 1 mc). The net result is a double conversion converter using only one oscillator stage, and since both the sum and difference frequencies are used there are no superfluous hetrodynes left over to cause whistles and squeals as you tune across the band.

While it was primarily designed for mobile use, it will make a real fine base station or portable receiver when used in conjunction with a small transistor radio. All should be inclosed in a metal box to prevent BC pickup. A few turns of wire around the antenna coil hooked between the converter output and case ground should provide adequate coupling.

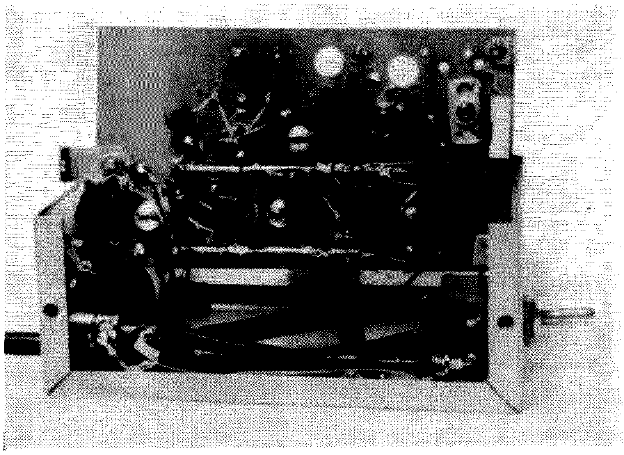
Construction

The converter was built on a phenolic board cut to fit inside a 5¼ × 3 × 2⅛" Minibox. The output cable, input jack and battery are mounted on one end and the switch on the



Coil Data

¼" slug tuned coil forms
L1—10T #23 hookup wire
L2—2T on cold end of L1
L3 & L4 same as L1 & L2
L5—20T #26 coil wire
L6—4T on cold end of L5
L7 & L8 same as L5 & L6



Inside view of converter.

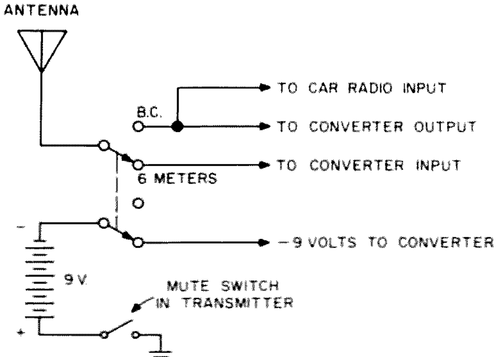
other. Major components are mounted on the board in the same relative positions as shown on the schematic. The input and output stages are at opposite ends and sheilded cable is run right up to the circuit terminals to prevent stray pickup. Keep all leads short.

I used an internal battery to simplify installation, and to avoid BC pickup and ignition noise from auto wiring. Current drain is only 4.5 ma.

Tuneup

Get the oscillator going first, then adjust the other coils for best response. After installing the converter in your car adjust the output trimmer for best reception on 6 meters. Switch to BC and adjust the antenna trimmer on the car radio for best broadcast reception. Repeat until no further improvement is noticed.

As may be expected, a super-sensitive receiver will pick up considerable ignition and other electrical noise when used mobile. It is assumed that suppression components will be installed on your own vehicle. However this does nothing for noise from other less concerned motorists. It is highly recommended that a tube type series gate noise limiter be installed on your auto radio. Circuits designed for citizens band mobiles work quite well.



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Gladstone, Oregon

Hints for Microwave

Many interesting articles on microwave have been written. This article merely condenses these into practical ways to start.

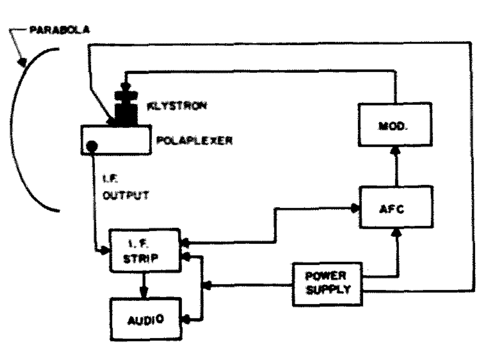
The three main objections to the use of microwave frequencies are: 1) too complicated, 2) hard to find parts, 3) nobody to talk to on these bands. Let's take these one by one:

To counter the first argument one must first look at some of these articles on the subject. For instance, my first construction project was the Beer Can Polaplexer[1] for 3300 mc.

This project involved obtaining a klystron (a tube for microwave frequencies), a mixer diode, an octal socket, an old coax fitting, a piece of copper tubing and a beer can. The total cost was $3.05 (and they say microwave is expensive)! As for a power supply, I used an old stand-by, two vr tubes in series. This is a lot simpler than the electronic regulation specified in the article. Just be careful; the klystron shell is hot with B+.

One power supply providing regulated B+ of 300 volts and a regulated variable power supply of negative 0-150 volts should power all of your different units. The negative voltage on these tubes need not be elaborate as the current drain isn't more than 7 microamps.

The next band I tried was 10 kmc, using an old radar receiver module. I stripped this down to the waveguide, mixer crystal mount



Block diagram of system.

and then mounted an octal socket above the injection hole for the tube output probe.

Tubes for this band must undergo a slight modification. File off the weld on the strut bolts and then turn the bolts until they become tight (usually about two turns).

The next band encountered was 2.3 kmc.

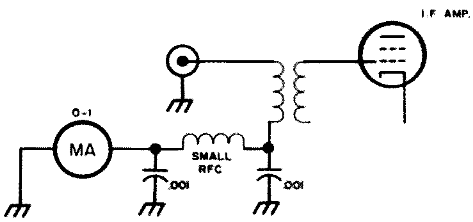
Some interesting articles on this band were "CQ 2400"[2] and "Pulse—a Practical Technique".[3] In the first article a super-regen transceiver was described. It could be put on 1296 mc by changing the cavity. The cavity used for this transceiver is somewhat difficult to construct, so I'd use the one described in the 1955 ARRL Handbook. The pulse article described a wide-band transmitter, and receiver for better efficiency on this band.

5650 mc seems the hardest nut to crack. There is a shortage of parts around, but it was found that it was because of a lack of tube listings. A couple of good articles on this band were: "Amateur Duplexing on 5650 mc,"[4] and "Experimental Transceivers on 5650."[5] The first article describes how klystrons work and how to operate them. The second article describes an operational setup. The afc is worthy of notice since it allows the tubes to "track" each other.

To counter the objection as to the availability, parts can be obtained from various wholesale houses and surplus stores. For 3300 mcs, the 726A klystrons are available from J. J. Glass for $2.50 each. The 428A (order WL428-a) is available for about $6.50 each, and will work in the 5650 mc band.

As for the 10,000 mc band, the 723 tube can also be obtained from J. J. Glass. Don't order the 723a, 723b, 723a/b, or 2K25, as these are the same tubes as the 723, and usually cost more. These tubes cost $2.00 ea.

An *if* strip (see block diagram) can be obtained for 95c (less tubes) from Columbia. A few 33c tubes should get this going in short order. Mixer diodes can be obtained for 4-5 for $1.00.



Connections to *if* amplifier

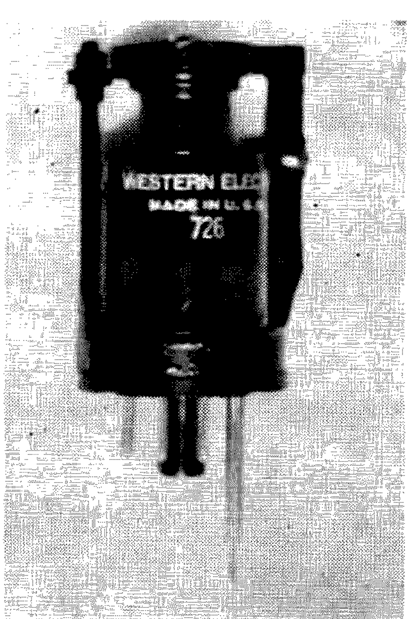
Sockets for klystrons must be modified. Drill out pin 4 of an octal socket to accept the coax probe from the tube. Waveguide can be obtained, but it is usually high priced, so use old pipe, beer cans, fruit juice cans, etc.

A polplexer is a device that allows you to operate duplex using the same tube as local oscillator and transmitter. The mixer probe is 90° out of phase with the tube's output probe. It would be best to mound the diode antenna at the same place as the output probe. Since this is physically impossible, it's mounted ½ wavelength from the tube's probe. All of this is mounted in a waveguide.

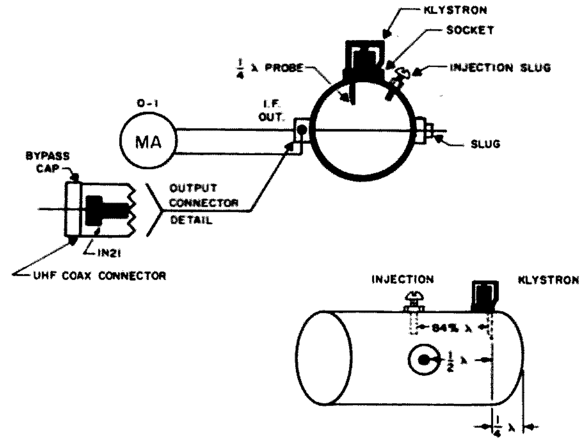
Waveguide is a form of a high pass filter that will not pass any frequency lower than a half wavelength of its inside diameter. The tube should be placed a quarter wavelength from the sealed end of the guide. An injection probe should be placed at about 84% of the half wavelength (see illustration). The mixer probe's length, and the injection screw should be adjusted for maximum xtal current. The probe is adjusted by a slug. See illustration.

A few rules concerning these units are:

1) Make sure that the waveguide is basically free of dents.



Klystron: Picture on left, connections at right.



POLAPLEXER

2) If you use a big dish, check frequency before installing into antenna. This can be done by an outgrowth of Lecher wires. Hook up a 0-1 milliameter to the *if* output. Next place a piece of metal plate about half wavelength from the end of the waveguide. Move the plate, and look for a dip in crystal current.

Mark this spot, and move the metal until another dip is observed. Measure this distance (in centimeters), and then use this formula:

$$\text{frequency in kmc} = \frac{150}{\frac{1}{2}\ \text{wavelength}}$$

3) Use the same *if* at each end so that both stations will track each other.

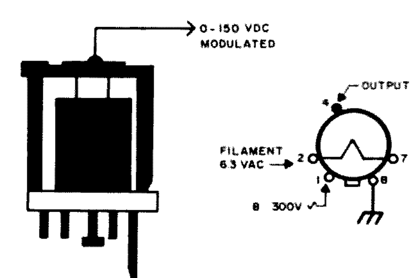
As for the third excuse (nobody to talk to), build two and loan one to a friend.

Dishes

The hardest part of getting on microwave is to find an antenna. A few surplus houses have them for sale. Fair Radio Sales has a nice one for less than $25.

Remember to mount the polplexer at dead center, and out from the dish about ½ the diameter of the dish.

KLYSTRON



BIBLIOGRAPHY

1. "Let's Go Microwave." **QST,** June 1958.
2. "CQ 2400 mc." **QST** July 1946.
3. "Pulse, a Practical Technique." **QST,** Feb.-May 1963.
4. "Amateur Duplexing on 5.6 Cm." **QST,** Jan. 1946.
5. "Experimental Transceivers for 5660 mc." **QST,** Aug. 1960.

. . . K7ZFG

Richard W. Solomon W1KSZ

New Power Tube

A few months ago at the IEEE show in New York City, the Tung-Sol Electric Company introduced a new tube, called the 8236. It is a multipurpose beam power pentode built mainly for use in horizontal output circuits and rf power amplifier. In most cases it will directly replace the 6DQ6, resulting in cooler operation.

The tube itself has a carbon anode, and this type takes plenty of abuse, and a borosilicate, or hard glass bulb. This lets the tube operate at 250°c continuously. In ICAS amateur operation, the tube can take a maximum of 1200 volts on the plate with a maximum plate current of 230 milliamperes. Efficiency runs about 70% up to 30 megacycles, with some drop-off above that. Typical operation, as amplifier up to 30 megacycles is as follows:

plate voltage	700	900	volts
screen voltage	140	145	volts
grid bias	−75	−77	volts
plate current	200	225	ma.
screen current	14	11	ma.
grid current	3	3.5	ma.
drive	0.25	0.25	watts
power input	140	200	watts
power output	105	140	watts

The major use of this tube as I see it will be as SSB linear amplifiers, but my use was as a modulator. With a pair of these tubes, and 1000 volts on the plates, I got 165 watts output. This was sufficient to modulate a 330 watt transmitter on 50 and 144 megacycles. The schematic is straight forward, and the only special item is a modulation transformer obtained from the surplus market. But any transformer in the 100 to 150 watt region will work all right.

The modulator I built occupies a 5 × 10 × 3 chassis and presently runs 125 watts output with 750 volts on the plates.

Further experimenting with this tube is planned on 6 meters and as a SSB linear amplifier.

The best news has been saved 'til last: the price is lower than the good old 6146.

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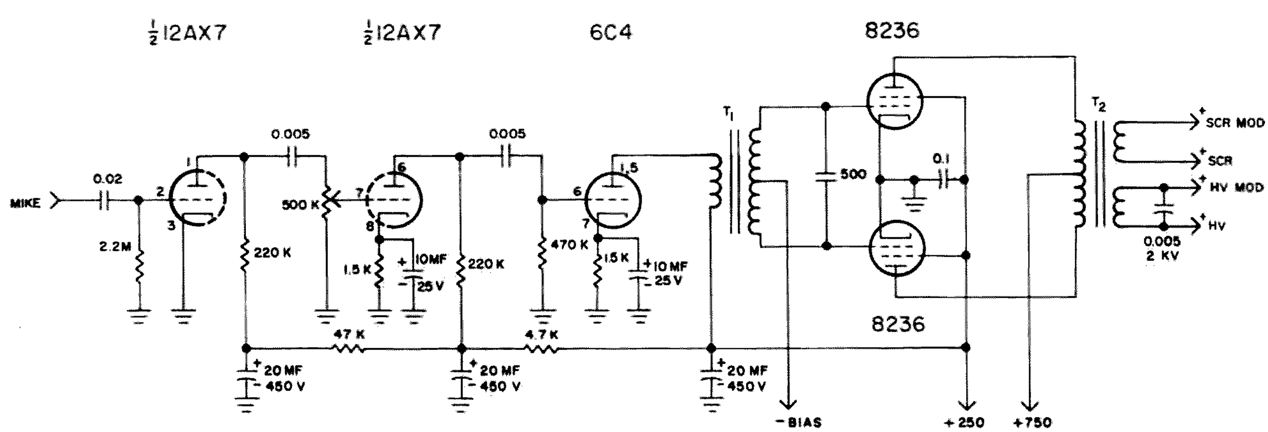
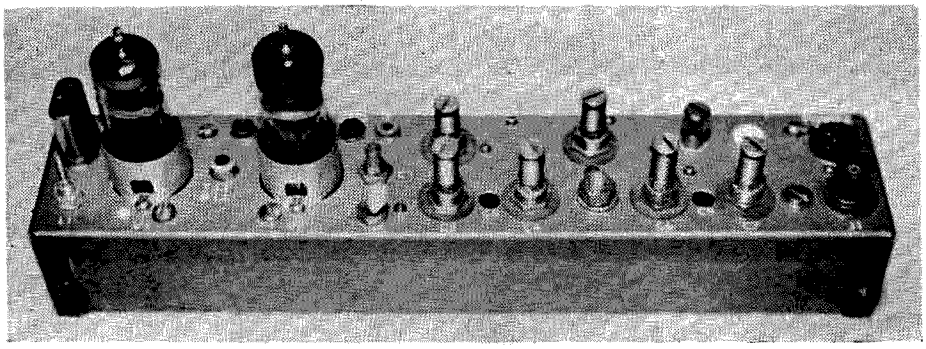
Notes

All capacitors in mfd
T_1—Stancor A-63-C
T_2—Barry 125 w modulation transformer
adjust bias for resting current of 40 ma





Two tubes and one varactor get you on 432.

A Hybrid 432 mc Exciter

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Lot B-39
Des Plaines, Illinois

When the ATV bug bit me a short while back, I had to take action. The first step, the TV camera, was not too difficult. However, getting the video on the air was another matter entirely. Since I live in a mobile home, space was the prime consideration. After looking at photos and actual ATV stations, I was set back somewhat. The space required was tremendous (or so it seemed to me.) I then set down all the things needed for ATV besides the camera and TV receiver. The result was four tubes and a great deal of semiconductors to fit in a small cabinet on the desk top. Two of the tubes and one of the 'fore mentioned semiconductors are the subjects of this article.

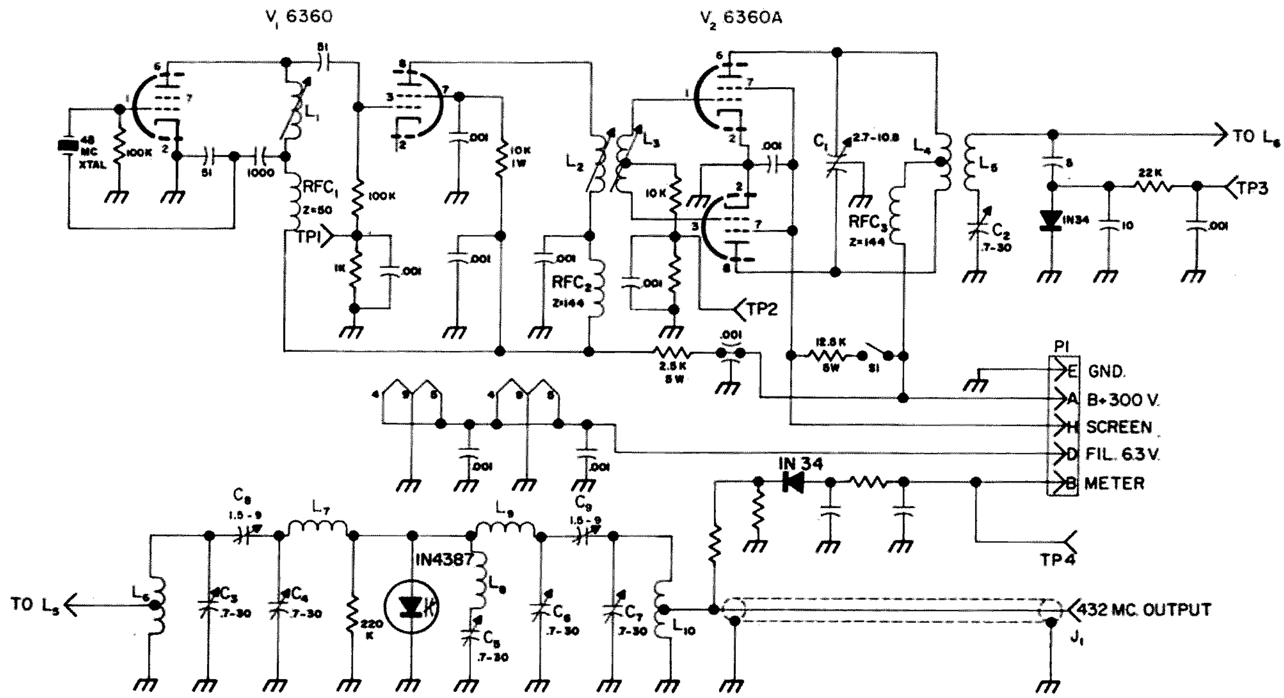
The exciter for my rig had to be small and not very hungry for power. Semiconductors could have been used throughout, however, on a cost basis this had to be ruled out. Therefore, a compromise was made and the hybrid circuit was chosen.

The line-up starts with a circuit previously published[1] but with minor changes. The heart of the unit is a varactor diode. Although these diodes are not in the "cheap" class, they have many things in their favor which overcomes some of the monetary objections. One of the prime considerations is that they consume no power other than their excitation. Another is that the little devils are quite efficient when tuned properly. My particular diode gives 75% efficiency which is nothing to sneeze at when thinking in terms of a 2C39 tripler for an example. Another minor factor in their favor is the fact that when used properly they have practically an unlimited life span.

The particular diode I have chosen is a 1N4387 made by Motorola. This diode can handle a maximum input power of 40 watts rf. When being driven with a 6360, the 1N4387 can loaf along. No pains were made in heat sinking this unit other than bolting it to the mini-box chassis.

The line-up starts with ½ of a 6360 as an overtone oscillator. This circuit drives the crystal quite hard so care must be taken or you may ruin your rock. The values of the capacitive voltage divider shown worked with my particular crystal but may have to be juggled somewhat to give adequate output to the following stage. The 51 pf capacitor should be a

1. Amperex—Application Bulletin, 6360. P. 17.



Coil Table

L1 15 turns #24 enamel 1/4" dia. slug tuned form—close wound.
L2 5 turns #16 enamel—close wound.
L3 5½ turns #14 enamel—center tapped —9/16 long above coils wound on 9/32" dia. paper form double slug tuned 3/16 spacing between L2 and L3.
L4 6½" turns #16 enamel—center tapped —3/8" dia. each half of coil 5/16" long. 1/4" spacing between coil halves.
L5 2 turns #16 enamel. 3/8" dia. placed at center of L4.
L6 7 turns #20 1/4" dia.—5/8" long—tapped 2 turns from cold end.
L7 same as L6—no tap.
L8 3½ turns #16 1/4" dia. 1/2" long.
L9 2 turns #14 1/4" dia. 3/8" long.
L10 3 turns 3/16" wide, 20 gauge brass strap 3/8" dia. 1 1/8" long—tapped at 1 turn from cold end.
C1 2.7-10.8 E.F. Johnson 160-211.
C8, C9 1.5-9.1 E.F. Johnson 189-4-1.
C2-C7 .7-30 Johanson JMC 1902.

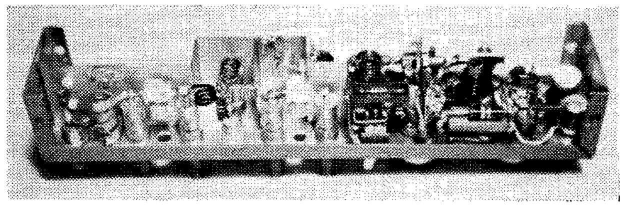
bit larger in value when firing up the oscillator for the first time. When the oscillator is functioning properly, then decrease the value, making sure that the crystal can does not get excessively hot to the touch. The original article I borrowed this circuit from used a 27 pf capacitor in this location; however, I found out the hard way that this drove the crystal too hard.

The second half of VI is a conventional tripler stage. Once again I had to deviate from the original circuit which used capacity coupling from the tripler to the final. This arrangement did not provide sufficient grid drive in the final stage. This was then changed to a double tuned, inductively coupled configuration, the result of which now produces a surplus of drive!

V2 is a standard circuit for the 6360 as a straight-through amplifier at 144 mc. A shield is used across the center of the tube socket which precludes the necessity of neutralization. When this stage was first fired up, I measured 20 watts output. After dropping the grid drive and screen voltage down to proper values, the output was 17 watts.

This power is then coupled to the final varactor tripler stage to give a total power output at 432 mc of approximately 12 watts which is sufficient to drive my 7457 final grid modulated stage. A tripler with fewer components can be used; however, the efficiency will suffer. You will note that there are no traps used here since this stage is to be used in conjunction with a final that will have a tuned input and output. Any 144 mc and/or 288 mc signals will be tuned out at the final stage. If a tripler of this type is to be used as an output stage into an antenna, then it may be wise to add a few traps.

The entire exciter is built in a standard 10 × 2 × 1⅝ inch mini-box. Detailed layout is not included because you may wish to make changes to suit yourself. The general layout can be seen from the photos. Sharp eyed readers will notice that the tube sockets in my model are submounted but this was done only because of a height-space problem in my par-



Bottom view of 432Mc exciter.

ticular cabinet. Standard flush mounted socket construction will do just as well. When wiring the varactor tripler be sure that all coils are at right angles to each other to prevent interaction and stray coupling.

Wiring will of course follow good VHF/UHF construction practice. After checking all wiring thoroughly, filament power can be applied. Plug a low range milliameter or voltmeter into TP1, open switch SI in final screen and apply plate voltage. This should be kept at about 200 for initial testing. Tune LI for maximum meter reading. Next L2 and L3 can be tuned for maximum with the meter in TP2. After this preliminary tuning, 300 V can be applied and the crystal capacitive divider adjusted as explained previously. Now we can proceed to adjust the coils in the final tripler stage with a GDO. Then set C5 at minimum capacity, put a meter in TP3 and put a dummy load on the output. Be sure that your load looks like a fairly resistive termination at these frequencies. Close SI and apply power. Quickly adjust C1 and C2 for maximum reading at TP3. With your GDO set to read output, adjust C3 for maximum at L6 and C4 for maximum at L7 (144 mc). Then set C6 for maximum at L9 and C7 maximum at L10 (432 mc). Put meter at TP4 and tune C5 for maximum output on meter. Now go back and adjust C1 thru C7 for maximum. The most critical adjustment is the idler circuit C5 and L8. If everything is working properly you'll have the following readings: .75 ma at TP1 and 3 ma at TP2. Power output will be approximately 10 to 12 watts.

For those who wish to decrease the output to drive a final, a 15 to 20 K rheostat can be connected from V2 screen to ground enabling the screen voltage to be lowered, thus decreasing the plate current.

I would be interested in hearing from those who construct a similar unit and their results. I'm sure you will be well satisfied with the operation of this Hybrid.

My many thanks to Jerry W9QXP for his introducing me to varactors and their possibilities.

Be seeing you on TV, I hope.

. . . W9SEK

A 5\8-Wave Vertical Antenna

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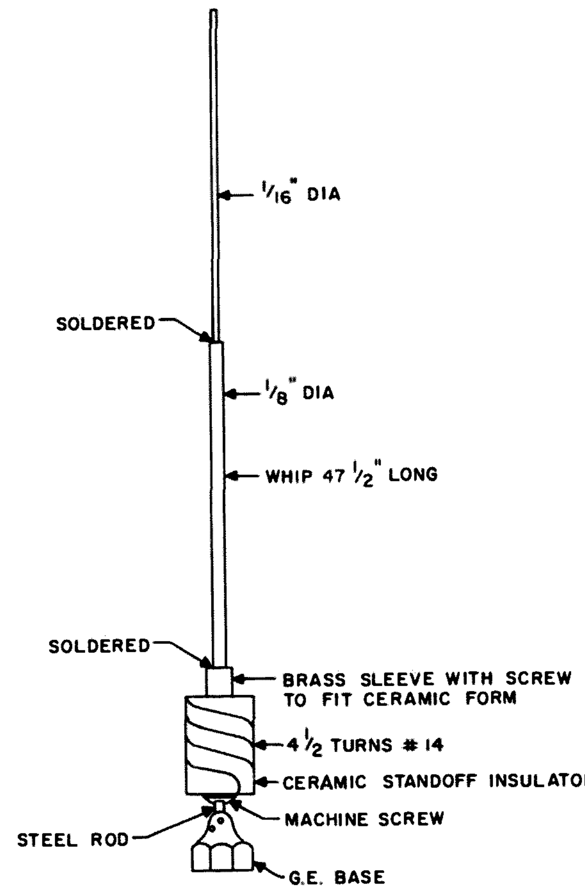

Having a desire to improve coverage from my mobile station operating on 146.94 mc, I have scoured every ham magazine and publication that I could find, looking for information on the ⅝ wavelength vertical antenna. Finding none, I decided to try and design one myself. The following is the result of about two days' experimenting, and about four hours work on the final assembly and adjustment.

The antenna has a ⅝ wavelength radiator, based loaded to resonance as a ¾ wavelength antenna.

The coil form is a ⅝" dia. × 2" long ceramic standoff. The whip is made of a 30" length of ⅛" diam. steel rod, with a length of 1/16" rod soldered to it to make a total length of 47½". The whip was made in this manner because I could not find any material of suitable length. The rod is a stock item at most hobby shops and model stores.

A machine screw which would fit the ends of the ceramic form was drilled through the center with a 1/16" drill. A short length of 1/16" steel rod (the harder the better) was soldered in the resulting hole so that the rod is even with the end of the screw. The rod was then cut to a suitable length to fit in the base section of a G.E. rooftop antenna (the screw-on whip base). The base of the whip is inserted in a brass coupler made from a ½" length of brass tubing that has been tapped for a machine screw that will fit the ceramic coil form. A machine screw is screwed into the coupler for a length of ¼", the base of the whip is inserted from the opposite end and the three are then soldered together to make a rigid unit. Care should be taken to keep the solder off the threads of the machine screw.

The whip and the screw with the steel rod are screwed tightly into the ceramic form (not so tight as to break the ceramic).

A length of #14 copper wire is then attached around the head of the machine screw. A coil of 4½ turns, spaced about ⅛", is then wound on the ceramic form, and the end of the wire wrapped around the base of the whip. Both ends of the coil should then be soldered in place. The whip is then mounted on the antenna base by inserting the steel rod in the base and tightening the two set screws.

The antenna is adjusted by spreading the turns or squeezing them together while watching the reflected power on an accurate reflected power meter. A liberal coat of coil dope will hold the coil in place very well.

With this antenna, I have realized a gain of about 2.5 db. The antenna has been duplicated here with the same success by another local ham. It is easy to build, and I am sure that many other methods of construction will be brought to mind with just a quick look into the junk box. Try this one; it works.

. . . K4DJG

Clean-looking construction with minimum trouble.

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The Johns Hopkins University
Applied Physics Laboratory
Silver Spring, Maryland

Printed Circuits—Almost

How many times have you read an article about a piece of equipment which was just what you were looking for, but required a printed circuit board? Printed circuits are a wonderful method for building modern, compact gear with exact duplication of the original unit. But what average ham has the necessary material in his junk box and knowledge to duplicate a printed circuit?

The articles dealing with modern electronic techniques certainly should be presented to the amateur fraternity to keep him abreast of the latest developments. However, the chances of the individual amateur's ability to obtain the equipment to produce an etched circuit are practically nil. Having had the problem of producing printed circuits in the shortest possible time and with a minimum material has led to a technique that is most certainly in the realm of many hams. This technique will not produce a printed circuit, but will enable one to make a very reasonable duplicate with very little material and will not require any special tools or exotic equipment.

If you have a favorite printed circuit that you wish to duplicate, don't give up yet. Take the print of the circuit and trace it out. Obtain a piece of bakelite or epoxy insulating material 1/16" thick without copper coating and cut to the required size. It might be advisable to add ⅜" on one or two edges if mounting provisions have not been made. Place the print or tracing over the blank board and tape firmly in place. Using a scribe or center punch, lightly mark or punch the centers of all solder pads and terminals. Don't try to punch a large hole in the bakelite material; it will probably break. Using an appropriate drill (this will depend on the eyelet or terminals you select. A 1/16" drill or #52 is about the approximate size). Drill all holes. The terminal holes are usually larger, and these can be re-drilled to the correct size (#48 drill). Remove the paper copy and insert an eyelet in each hole, with the large diameter of the eyelet on top of the board corresponding to the solder pads. Using an ordinary center punch, set the eyelets in place by lightly taping the small end of the eyelet. You don't have to set the eyelet firmly against the board; you need only to keep it from falling out. The broad end of the eyelet should be placed against a wooden surface to prevent excessive deformation. After all of the eyelets have been set, insert any terminals, if used, in the remaining holes. Terminals will be required for all external connections even though the original may have used a solder pad. Use a punch to set these firmly in place. Check to determine if the terminals extend from the printed side or the back side (component side) of the original board.

Insert all components from the back side (unprinted side) and lightly solder each lead to the eyelets or terminals. Merely fill in the eyelet, don't solder the components as you normally do. The final soldering will come

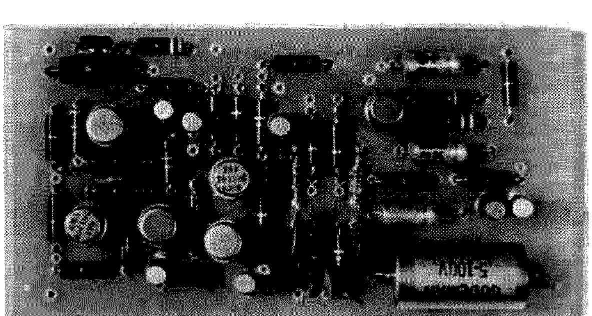


Fig. 1. Top of board.

Fig. 2. Bottom of board.

later. A word of caution: DON'T USE A SOLDERING GUN. There is no way of knowing the tip temperature, and excessive heat can damage components or the board itself. Use a light iron, 40 watts or less.

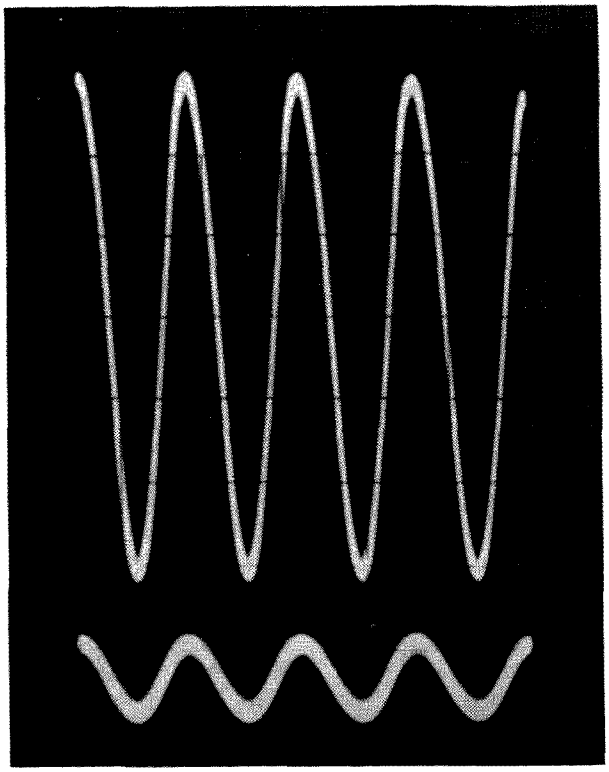
After all of the components have been lightly soldered in place, return the board to its original position, components down and the leads upward.

Clip all leads to about a ¼" length, (refer to the original printed circuit), using #24 or #26 tinned copper wire bend, and solder the wires in place, duplicating the original printed circuit. Solder each junction (wire, eyelet, and component lead) using the normal amount of solder. It is not necessary to wrap the wire around each lead except at the start and end of each length of track. Cut off excess wire leads so that circuit wiring now looks like Fig. 2. Upon completion, the wired version should look like the original printed version and should work just as well.

. . . W3ITO

1. : Lafayette Radio Corp. part 19G6811, Type PEY-12, 125 eyelets .062 dia. X .093 long @ 60c per package.
2. Terminals: Allied Radio, Cambion part #2027B @ $1.46 per 100.

Photographs by Fred Harvey W3AME



Using an electronic switch, you can display two traces simultaneously on a scope, such as input and output of an amplifier. Film speed 125, f/22, 20 second exposure.

Fred Blechman K6UGT
23958 Archwood Street
Canoga Park, California

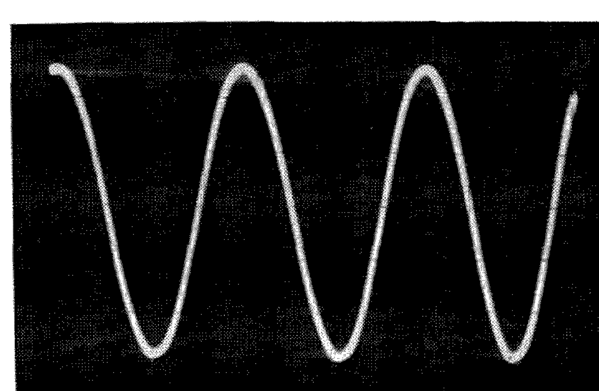
Scope Pix Trix

While the home experimenter or TV technician normally doesn't need "proof" of proper performance, there are many times when waveform analysis of a photograph is more convenient than trying to measure the pattern on the scope screen. To illustrate articles for technical papers, or for magazine articles, or for club meetings, one scope picture is worth the proverbial thousand words. By using a few things you probably have, together with some of the following hints, you should be able to get good scope photos every time.

To begin with, you must have a camera. This does not have to be an exotic camera at all, and, most 35 mm cameras have all the requirements.

The closeup lens? Just about any old lens from a broken child's telescope or binocular will do. The lens should be large enough in diameter to cover the camera lens. Mount the closeup lens the best way you can over the camera lens. Set the exposure to "time" or "bulb", and the focus to infinity. Put a piece of ground glass or waxed paper over the area where the film goes, and hold the shutter open. Using a well-lighted object, move the

A sine-wave display is one of the most common seen on scope screens. With the scope brightness up to full, this exposure was taken for 10 seconds, using ASA 125 film at f/16.



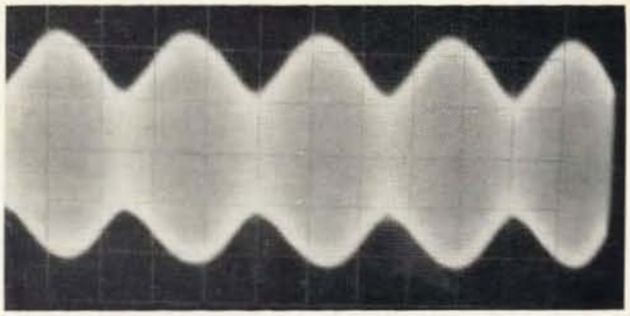
camera in close until the image is clear. Use an object with some kind of printing and place it upside down, so the image is right-side-up. Find the point of perfect focus.

Use the *smallest* lens opening (f/16 or f/22), which is desirable in closeup photography to keep the whole picture in focus. Now try using the scope screen as the object to see if you get enough of the screen in the photo at the focussing distance. This whole procedure is really very simple and straightforward, and you can try several different lenses in less time than it takes to describe.

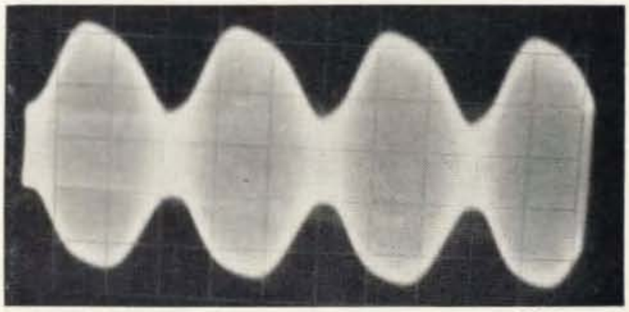
Once you've selected the closeup lens, load your camera with Plus-X (ASA speed of 125) or your favorite black & white film. Set up the camera so the lens is aimed at the center of the scope screen and at the proper focussing distance. Don't try to use the camera viewfinder since parallax at this close range will be severe; "eyeball" the aiming. Install a cable release. Set the lens to infinity, the shutter to "time" and the lens opening to f/11, f/16 or f/22. Now put the display you wish to photograph on the scope screen and adjust the scope sweep and sync controls for a stable trace—any drift or shift during the exposure will ruin the shot. Turn the scope brightness up to full, and readjust the scope for best focus. Check the camera aiming and distance, and look at Figure 1 for the exposure time. For a particular film speed and f-stop, Figure 1 gives recommended exposure times which take into consideration the light attenuation of the uncoated closeup lens you are using. Of course, great variations can be expected in the brightness of different oscilloscopes. So plan on using one roll of film just for experimentation, and use exposures of ¼, ½, nominal, 2-times and 4-times nominal on different types of displays, keeping a careful record for comparison with the negatives when they are developed. No special film processing is required. You may get only a few good shots on the first roll, but from then on you'll know the proper exposure to use in your case.

One other caution: room lighting should be held to a minimum during the exposure, since reflections from the scope tube can ruin the photo.

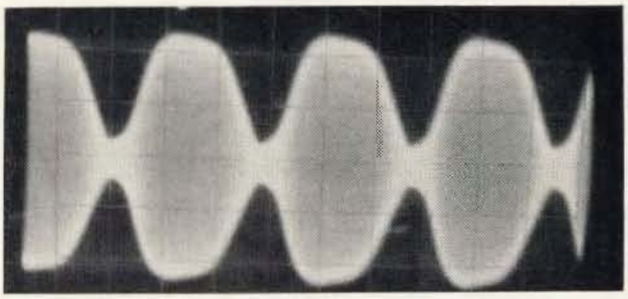
If you have a Polaroid camera, you can use the same techniques, but the extremely fast film speed will allow you to take snapshots, and you can assess the results right away and correct the exposure if necessary. Using the 3000 film speed, set the shutter at LVS 11 for the first try. A time exposure is *not* necessary. . . . K6UGT



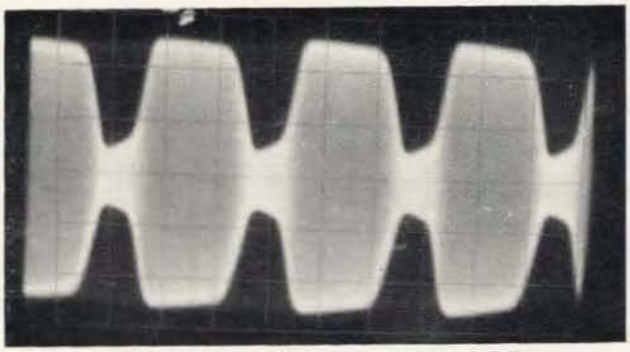
Here's a wave-envelope display of a modulated transmitter. The modulation percentage was only 30%. The following photos show attempts to improve the modulation. ASA-125, f/22, 30 seconds.



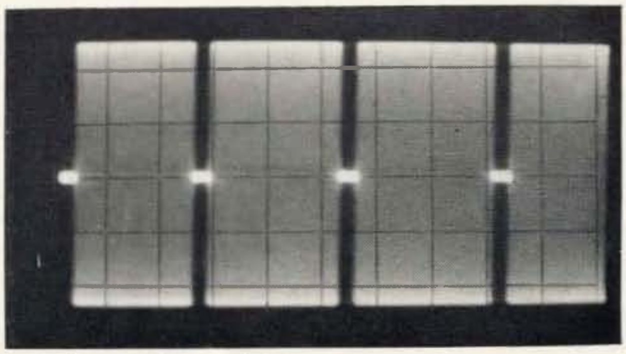
Modulation percentage is now up to 50%, but with some distortion.



Modulation up to 73%, but a little distortion.



Severe distortion of the modulated RF!



Pulse width modulation.

Clive Frazier K9FWF
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Milwaukee, Wisc.

Easy Higher Power

How would you like to increase the power of your transmitter by 1/3 with less than one minute's work? It is almost as simple as turning the rig on; that is, you simply change the final tube to a 6146 B. There are only two little requirements which must be met for the fast change. One is essential, the other is desirable, but few hams pay any attention to this detail until it is too late. The tube in the final must be a 6146 or one in its family. This is not in any way to discourage you from rewiring a tube socket to take advantage of this improved tube, but that takes more than a minute. Next, pay attention to your power supply, or you will be paying for a new one. Make sure it can handle a 1/3 increase in power requirements. If the tube is used in AM phone, there is not much that can be done because of the constant current requirements. However, in CW, SSB, or af amplifiers, where there is a continually changing drain on the power supply, an extra capacitor, 40 to 80 mfd in parallel with the output capacitor will do a lot to insure that peak current requirements are met. It will also lighten the strain on the power supply in general. Most equipment should be able to handle this extra increase, provided you do not place extra overloads on the supply and watch its temperature.

I recently wrote RCA requesting their latest transmitting tube manual for some homebrew work. They enclosed the spec sheet for this new improved tube, the 6146-B.

I bring this message to 73 subscribers, as a public service, because you will not read about this tube in any ad in 73. Would you like to find one day soon, Joe Ham down the street, who reads brands X and Y full page back cover color ads, suddenly has 1/3 more power than you? Certainly not!

All right, before you go spend some money, you want to know what it can do. This increase in power is accomplished by greater plate current with increased plate dissipation. An article in 73, Power Booster, July 1962, extolls the virtues of the 6DQ5 over the 6146. This was due to higher plate current at low plate voltage. With the 6146-B you can have your high plate current with high plate voltage. Bet those extra watts taste good.

There are other interesting items on the data sheet. At these ratings, the plates show no color. In other words, you will run it even harder. Being a 6146, maximum ratings extend through 60 mc with reduced ratings, 50 watts output CW, up to 175 mc. Good news for mobiles. The tube features the Dark Heater. It is nominally rated at 6.3 volts but can be run anywhere between 5 and 8 volts on the old car battery.

I'll be listening for your BIG signal on the air soon.

. . . K9FWF

Operation	Maximum			Typical			
	Voltage	Current	Input	Voltage	Current	Input	Output
AM plate modulation	600	180	85	600	140	85	65
CW	750	220	120	750	160	120	85
SSB Two tone Test	750	220	35 watts plate dissipation	750	125		65

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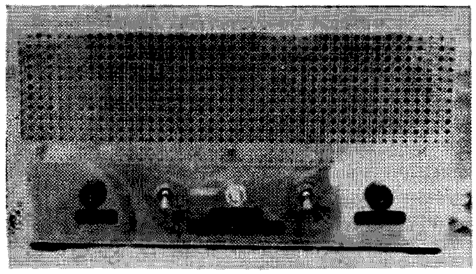
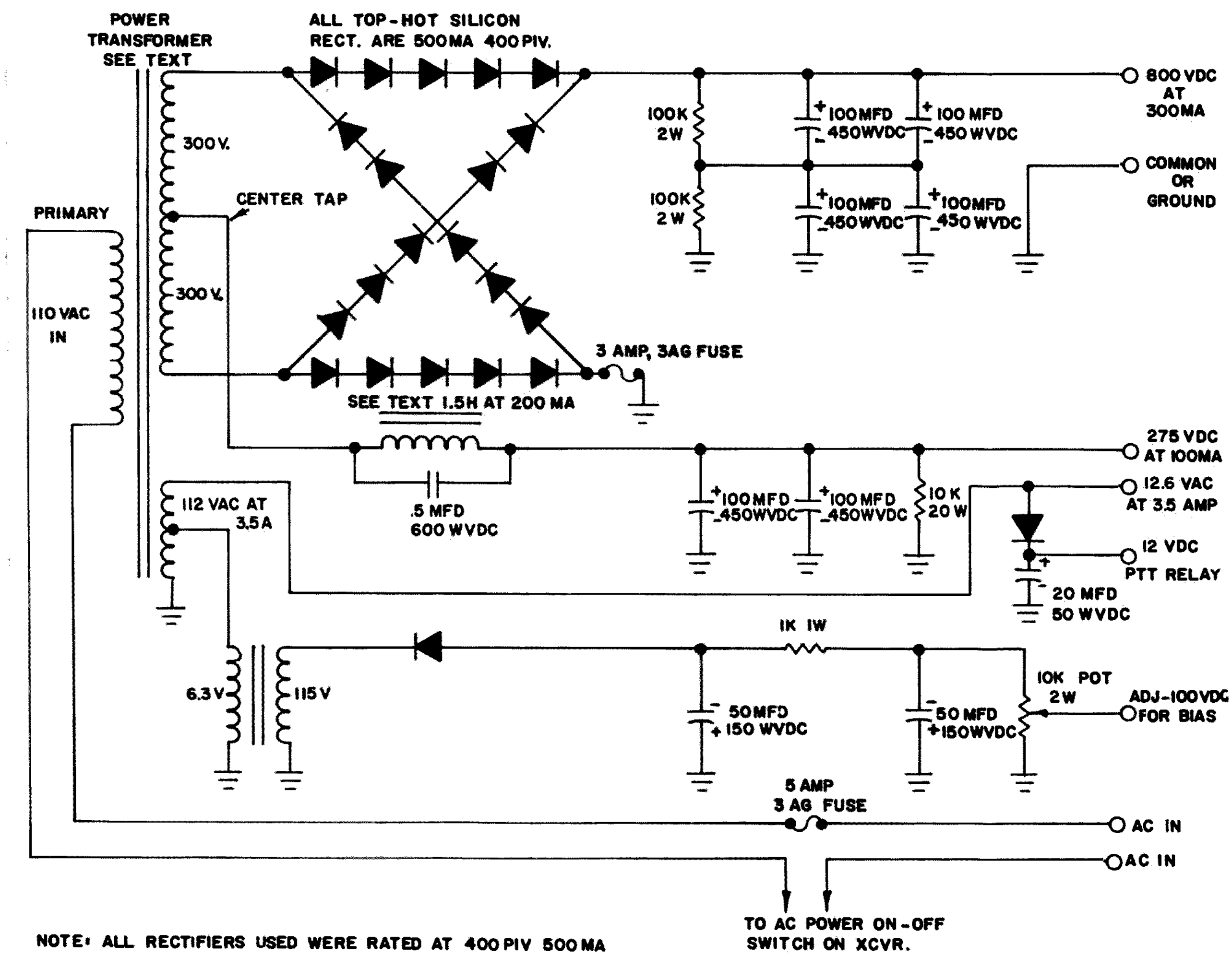
Tallahassee, Florida



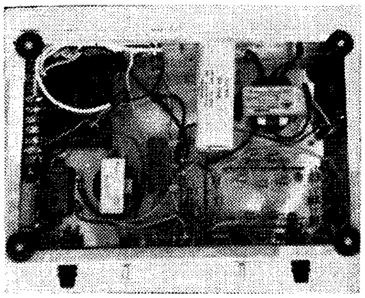
An AC Transceiver Supply

With the advent of many new supply-less transceivers, the cost of an ac supply must be considered if the transceiver is to be used at home. If you want to save a few extra dollars by rolling your own B+ supply, read on and see if this one won't fill that need.

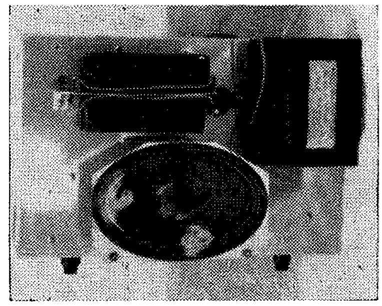
When I wanted to go on the air with my Swan Transceiver, I experimented with several types of transformer and rectifier circuits. The power supply herein described has proven to be a service-free high voltage supply with plenty of guts.



Omit .5 mfd capacitor across choke. Note that the winding labeled 112 vac should be 12.6 vac.



Bottom view.



Top view.

This circuit provides the following voltages:
800 vdc @ 300 ma ....transmitter
275 vdc @ 100 ma ....receiver
−100 vdc @ 50 ma (adj.) ....bias
12.6 vac @ 3.5 amps ....filaments
12.6 vdc @ 100 ma ....PTT relay

The transformer used in this circuit was from an old Majestic TV. If you have an abundance of goodies, perhaps you will have one of these jewels. If not, Merit will gladly sell you one. The Majestic transformer number is D-9.252A or a Merit number P-3055 can be used. It is important for long life and service that a transformer rated at at least 300 ma be used, but 400 ma is preferable. The one in my supply is rated at 400 ma.

Top-hat silicon rectifiers are used and I bought them on special at a parts house. Their ratings are 500 ma 400 PIV. I paid $6 for two dozen of these little gems. Five are used in each leg of the rectifier circuit. They are *carefully* mounted on four 8 pin terminal strips. Use a heat sink when soldering these top-hats together. A fuse in the ground return leg of the rectifier circuit will help protect your top-hat rectifiers.

The receiver B+ was drafted from the center tap of the transformer secondary. It develops around 275 vdc through the filter network. Use a Merit C-2994 or equivalent filter choke.

For the negative bias circuit a 6.3 vac filament transformer was reversed. With it reversed, I connected the center tap of the 12.6 volt filament winding of the power transformer secondary to the 6.3 winding of the filament transformer. A negative bias of 125 volts was developed through the capacitor input filter circuit. Note the polarity of the electrolytic condensers in this circuit. The exact bias needed can be adjusted with the 10K 2 watt potentiometer and a VTVM.

The last 16 months I have used this supply and tested it extensively. The voltage regulation is very good. The 800 volts B+ varies only plus or minus 20 volts while on the air. At this voltage I load my Swan Transceiver to 300 ma with no difficulty. Incidentally, the supply runs extremely cool under this load.

All of the components are mounted on an 8″ x 12″ x 3″ chassis. The transformer is mounted in the right hand corner of the chassis and to the left of it I vertically mounted the four 100 mfd filter condensers on a 2½″ x 5¼″ piece of aluminum. In front of the filter condensers I mounted a 4″ x 6″ speaker. This eliminates the need of having an outboard speaker.

The component mounting under the chassis is not critical. The sides were used to mount the 12 vdc circuit as well as the bias circuit. Sufficient space was found to mount the top-hat rectifiers and the receiver filter network. The chassis cover was made from perforated aluminum and was very easy to cut out and fit. It certainly adds beauty to the finished product.

If the diagram is followed, no complications should occur. Good luck—in the fine art of Home Brewing.

. . . K4PNJ

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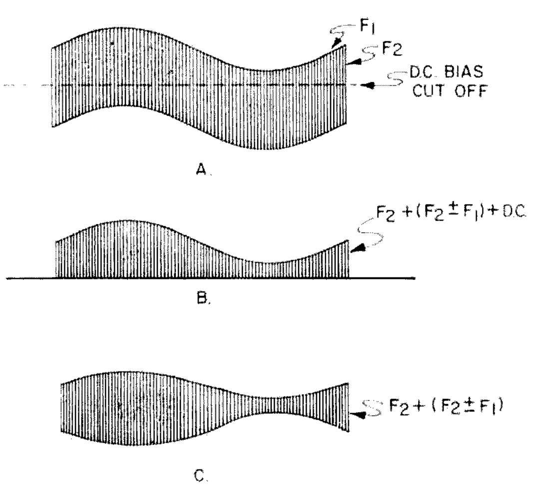
41 La Encina
Orinda, Calif.

Let's Understand Mixers

I certainly believe that of all the circuits that appear in communications equipment, especially in single side band gear, the least clearly understood is the mixer.

In modern communication equipment the mixer is commonly used for frequency conversion, for modulation, and for demodulation. A mixer can be defined as an electronic device which takes two signals and by its mixing action produces additional signals equal to the sum and/or difference of these original signals. Such devices are commonly referred to as diode detectors, product detectors, mixers, modulators, balanced modulators, converters, etc. All of these devices have one thing in common: at least two frequencies are mixed to produce additional sum and/or difference frequencies.

FIG. 1 MIXING OR MODULATION PROCESS



In the case of the common AM diode detector, the sidebands of the AM signal mix with the carrier frequency to produce a difference and sum frequency (both identical) which are equal to the original modulating frequency. With a product detector the action is similar, except that the carrier is supplied locally. The sideband signals mix with the inserted carrier to produce the difference frequencies which are equal to the original modulating frequencies. Frequency converters accomplish the same sort of mixing action, except that the resultant sum or difference frequency is usually in the rf range. Modulators, whether balanced or not, are again another form of mixer except that this time one of the input signals is audio, and the resultant mixer products are equal to the carrier frequency plus or minus the audio frequency signals applied. To say it differently, the resultant frequencies are equal to the sum and difference of the two mixed signals.

Now that we understand what mixers are supposed to do, let's look a little further and see how mixing action is accomplished without going into a lot of complicated mathematics. Fig. 1 shows graphically the modulation process. Fig. 1A shows where f^1 and f^2 are added with a proposed biasing level. Fig. IB shows the wave shape produced when the portion of the wave form below cutoff bias is removed.

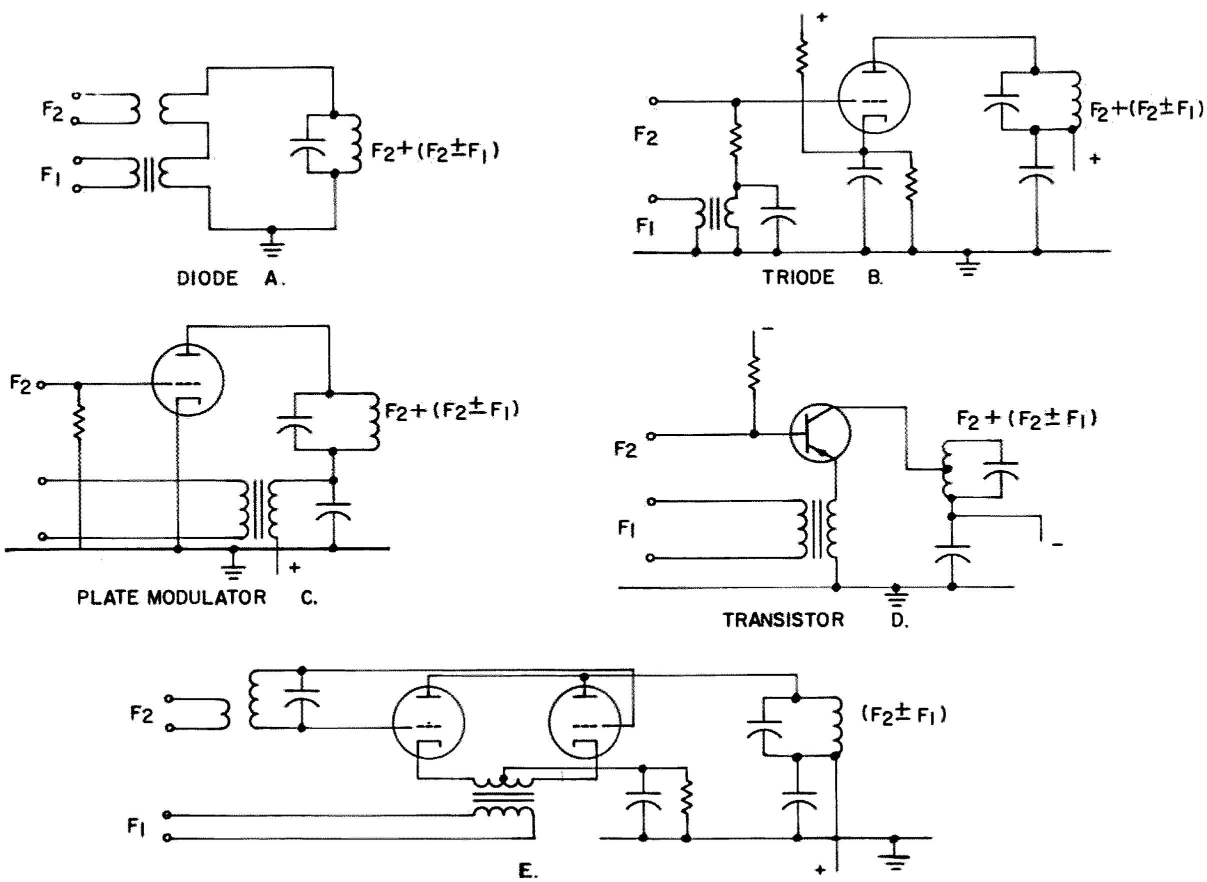


Fig. 2. Mixers or modulators. Put a diode in series with transformers in A.

Fig. 1C shows the wave form of 1B with the dc component removed.

In the wave form of 1A, only the fundamental frequencies f^1 and f^2 are present, but in the wave form of 1B, additional frequencies have been produced which are called mixed, modulated or heterodyned frequencies.

The difference between the modulated envelopes of Fig. 1B and Fig. 1C is only the existence of a dc component in Fig. 1B, but otherwise the envelopes are similar, and the envelope of Fig. 1C will appear after the dc component has been stripped by an rf tuned circuit.

When we now compare Figs. 1A and 1C we note that the upper parts of these two waves look quite similar but that the bottoms look different; the main difference being the absolute symmetry of the modulated wave against the partial symmetry of the added waves. All that has been done to create the wave form of Fig. 1B was the removal of the lower part of the wave form of Fig. 1A, thereby altering only the symmetry of the added wave. This change in symmetry or mixing can be easily accomplished in either tubes, transistors or diodes by biasing these devices so that conduction only occurs during the upper part of the wave form of Fig. 1A, above the dotted line.

In Fig. 2, examples of these modulator devices are shown.

Fig. 2A shows the common diode mixer. Figs. 2B and 2C show common tube mixers, and Fig. 2D shows a transistor mixer.

In all of these circuits several things are similar; two signals are mixed to produce a sum or difference frequency or both, and all of these devices are designed to be operative only over the upper half of the additive wave shown in Fig. 1A. Fig. 2A shows a diode mixer where the larger of the two input signals supplies biasing of sufficient amplitude to insure linear mixing with the smaller of the inputs. Fig. 2B shows a triode mixer in which biasing can be partially from the larger of the two input signals and partially from the dc cathode bias. Fig. 2C is the familiar plate modulator or mixer where one of the signals is fed directly to the plate and the other to the grid. Fig. 2D shows a transistor in a analogous circuit to the triode mixer of Fig. 2B.

Since the basic action of a mixer has been shown, let's go a little further and discuss some of the important facts about proper biasing, operating level etc.

Fig. 3A shows the operating voltages and currents of the diode mixer shown in the cir-

cuit of Fig. 2A, and Fig. 3B shows similar operation for the tube mixer shown in Fig. 2B.

In both of these figures the presence of both f^1 and f^2 in additive form are present at the input terminals. While both signals are shown series additive into the grid of the triode, either one of these signals may be similarly added by introduction into its cathode or plate circuit.

The output signals of both the tube mixer or the diode mixer are immediately recognized as the wave form shown in Fig. 1B which is the modulated or mixed envelope with dc component. By using a tuned circuit to remove the dc, we arrive at the recognizable common modulated envelope shown in Fig. 1C.

What has been discussed so far is just the basics of mixer operation, and it is now necessary to show how a mixer should be operated to produce the desired mixing frequency with as low a degree of distortion as possible.

In using the diode, the transistor, or the tube, there is a linear relationship between the applied control voltages or currents and

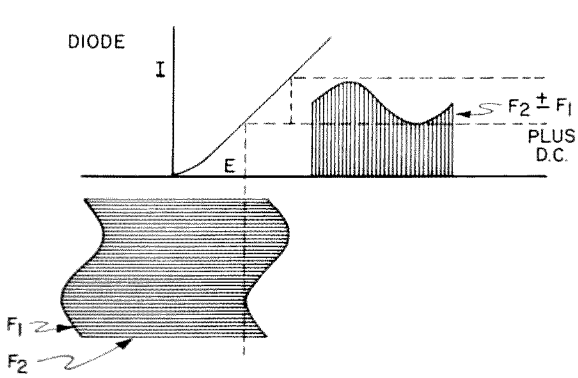


FIG. 3A

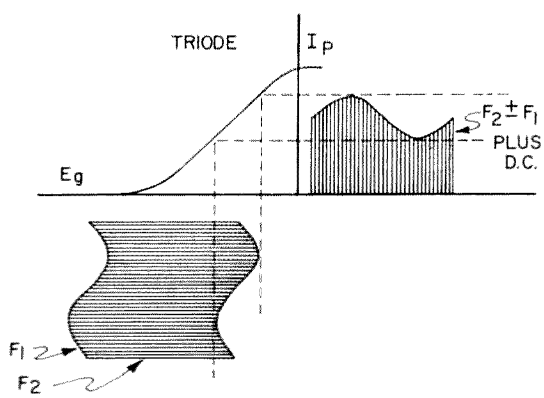


FIG. 3B

the output currents of these devices only over a limited operating range. It is over this limited range that mixing action should take place if undesirable distortion is to be minimized. With tubes or transistors, there are non-linear relationships between grid voltage and plate current, and base current and collector current in the cutoff and saturation regions of these devices. In diodes, there is a non-linear relation between applied voltage and anode current at low applied voltages. These regions should be avoided by proper choice of operating conditions.

Up to this point, you may be a little confused, since it has already been stated that the mixer must operate around the cutoff region in order to accomplish the desired symmetry change necessary to produce the modulated envelope. A little further discussion is necessary to eliminate this confusion.

In the output of a mixer, there will be present not only the sum and difference signals, but also the fundamental signals as well. We do not usually care if these fundamental signals suffer severe distortion, but we do care, however, if the sum and/or difference signals do.

Upon examination of the Eg-Ip and E-I relationships shown in Fig. 3A and 3B, this is seen to be easily attained by operating one of the signals over a range from below cutoff to the center of the linear operating range of the tube, transistor or diode and superimposing the other signal to be mixed at a sufficiently low level, so as to insure that the entire swing of this modulating signal (upper part) excurt only over the linear operating range of the device being used. As far as the bottom part of the additive wave form is concerned, it is only important that all of its modulating signal excursion occur below the cutoff of the device.

It matters very little whether mixing is done with a diode, transistor or tube. The basic action is the same, and equally good results may be obtained with any one of these devices. The obvious advantage of using tubes or transistors is that voltage gain or power gain is available as compared to a loss in gain in a diode mixer circuit.

Special converter tubes which are particularly designed for mixer service basically work in the same manner as described, except that provision is made to either bring the two signals to be mixed into separate high impedance inputs or to generate one of the two signals to be mixed in the converter tube itself.

Of course, there are a few more considerations with mixers that may be just as important in many cases as linearity. These are its ability to eliminate the fundamental signals from its output, the problem of undesirable mixing of two or more signals appearing on a common input, and the problem of harmonic and image suppression.

In the output current from any mixer, there will be a number of signals present. These will be the originating frequencies, the sum frequency, the difference frequency, and a number of other frequencies caused by harmonic distortion. The basic frequency that we are interested in, however, is either the sum or the difference frequency. These frequencies are present in the output of the mixer at a considerably lower level than the originating frequencies, and some means such as tuned circuits or filters are usually employed to discriminate against the unwanted signals. Often times, however, it may be impractical to supply enough suppression in this manner, where fundamental and mixed frequencies are too close for adequate rejection of the fundamental signals, or where, for economy reasons, it may be desirable to use fewer tuned circuits following the mixer stage and still obtain adequate suppression of the originating frequencies. In this case, it is possible to use any one of a number of balanced arrangements in which the fundamental and certain harmonics of the fundamental signals cancel in its output.

Fig. 2E shows a tube type mixer of the balanced variety.

This is only one of a variety of arrangements which may be employed with tubes, transistors, or diodes. The balanced mixer lends itself usefully also, where the carrier must be balanced out as in the case of a balanced modulator, or where mixing between multiple signals appearing at a common input should be attentuated, as in the case of a product detector.

There have been special tubes such as the 7360, built particularly for balanced modulator service. These tubes offer somewhat better long time balance stability, but otherwise have little else to offer in making better balanced mixers than are possible with conventional tubes, diodes, or transistors. The 7360 also is somewhat less flexible in use due to its common cathode arrangement.

As you can see, there is nothing at all difficult about understanding and designing the various types of modulators, detectors, product detectors and mixers to obtain excellent performance. Let's start designing mixers in the same way we go about designing rf amplifiers, that is, in a logical manner. . . . W6BUV

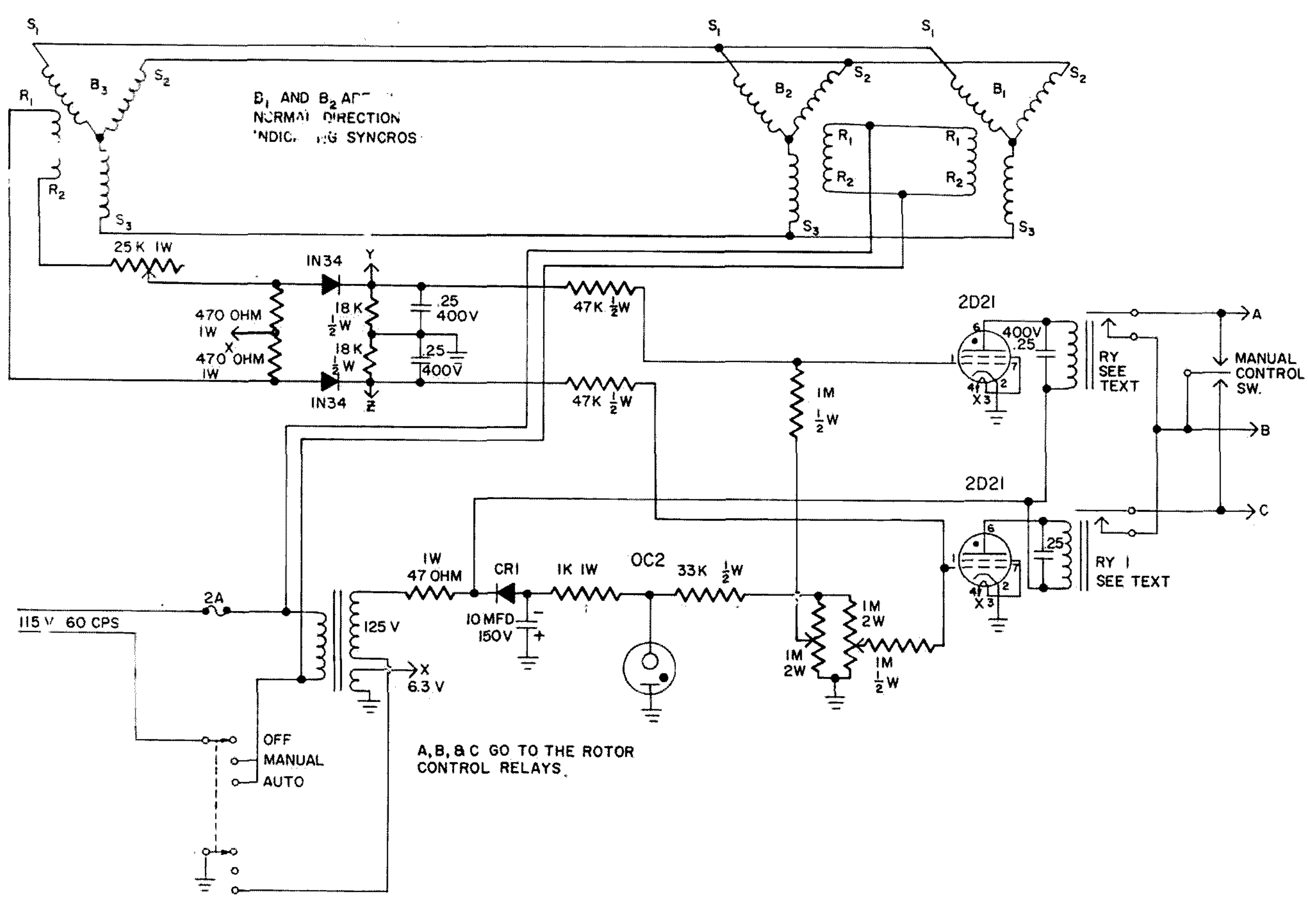
Roy Dancy WA4GTA
112 Marlboro Rd.
Portsmouth, Va.

An Electronic Antenna Control

One of the first problems that reared its ugly head upon setting up the shack after a tour of duty in CE land was controlling the direction of the antenna without watching the pointer crawl around. The circuit shown is the answer. It works like a charm, has given no trouble and none is expected for many years. Although in my case it is used with a prop pitch motor, it will work with any rotor system that uses syncros for indicating direction.

Most of the parts should be in the junk box except for the CT (control transformer) and a regular syncro can be used in place of it. There is nothing critical about the wiring. None of the adjustments need be placed on the front panel as they will hold until major part replacement is necessary. It is a good idea to place each bias adjustment pot next to the tube it controls. If you can rig a concentric system for the pointers, it takes up less panel space and is more convenient. I have this, the coax switches, SWR bridge and antenna relay all behind one 10½ inch panel.

Adjustments are easy. With the power switch in MANUAL, turn the CT rotor for zero volts between its R1 and R2 terminals. The pointer on the CT should be aligned with the pointer on the beam direction indicator now. Then turn the pots for maximum bias on the 2D21's. With the switch in AUTO, turn



Delete connection from bottom of 125 v secondary to 6.3 v winding. Delete connection from center of left 1 M/2 W potentiometer to top of this pot. The top relay is RY 2.

the rotor of the CT about 10 degrees to one side and reduce the bias on the 2D21 that goes to the positive point (Y or Z) on the phase sensitive detector until its relay closes. If the antenna goes away from instead of toward the CT pointer, reverse the R1 and R2 leads on the CT. The final setting for the bias pot is where the beam coasts to a stop when the pointers align up with each other. The bias on the other 2D21 is set the same way but on the other side. The sensitivity control is set to the point that gives the most reliable operation.

None of the parts are critical but circuit balance must be maintained for proper operation. RY1 and RY2 are 5,000 to 10,000 ohm plate relays. Any relay will work as long as it has enough sensitivity to be operated by the thyratrons and has enough resistance to limit the current through the 2D21's to a safe value. I used a pair of 10,000 ohm telephone type relays that were in the junk box. The CT was also in the junk box but most people won't have one. They are available at most surplus emporiums but if one cannot be had, all is not lost.

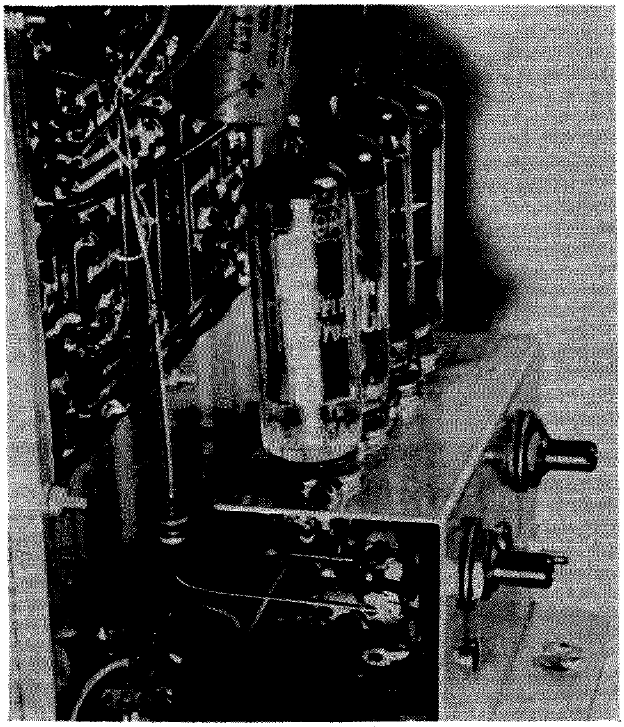
A regular syncro can be used by placing resistors in series with the S leads to reduce hum and motor action due to stray magnetic fields. These resistors will be about 1,000 ohm 10 watt wire wounds.

I hope your version works as well for you as mine does for me. It is a real pleasure to turn the knob to the direction that I want the beam and forget the antenna with no worries about twisted feed lines. Of course you should have limit switches for safety.

For more information about phase sensitive detectors, check Principles of Radar by MIT or the various books on syncros and servo systems.

. . . WA4GTA

Jim Kyle K5JKX
1236 N. S. 44th Street
Oklahoma City, Okla.



DC-izing an Oscilloscope

Though it's no longer in current production, the Heath Model OL-1 scope is still around in vast numbers. Thousands of these handy little 3-inch units were turned out during the years it was in the Heath line, and many of them are still providing excellent service.

Several months ago, I acquired one for general-purpose use. Cost was only $15; it had a burned-out 12AU7. Replacing the 12AU7 brought things back to life, and as I used the OL-1 I found myself preferring it to larger, more complex instruments. Only one thing was wrong; it was an ac scope, like most other inexpensive models.

While working on another project, I had occasion to examine the circuitry of the OL-1 to determine the maximum input voltage it could handle, and discovered that it could be converted to a dc instrument with a minimum investment in both time and money. Here's how to do it; the result is a lab-type scope at a total cost of less than $25. Even if you don't have an OL-1 around, you may be able to find one as inexpensively as I did.

Before we go into the details, let's take a brief look at the original circuit to see how the conversion from ac to dc amplification comes about so easily. The original circuit of the deflection amplifiers appears in Fig. 1; both the vertical and the horizontal amplifier are identical in the OL-1, so only one is shown.

Input from either the vertical-input jack or the sweep-selector switch is fed to a cathode-follower, with the gain control located at the cathode-follower output. The amplifier V1B drives V2 which operates as a longtailed-pair phase inverter, and is direct-coupled to the deflection plates. Spot deflection controls are in the grid circuit of V2.

V1 could be converted to a dc-amplifying stage easily were the cathode, grid-return, and ground for V1A all at the same voltage. Then both ends of the 50K gain control would be at ground for dc, and grid voltage of V1B would not change as the gain control setting was varied.

This target of ground potential at the top of the gain control exists only when no signal is present at the amplifier input, obviously. The "artificial ground" must have high enough impedance that both ac and dc signals can appear across it, and ideally should not change operating conditions for the cathode follower.

While we can't quite reach the ideal of having cathode, grid return, and ground all the same, we can make the grid return come

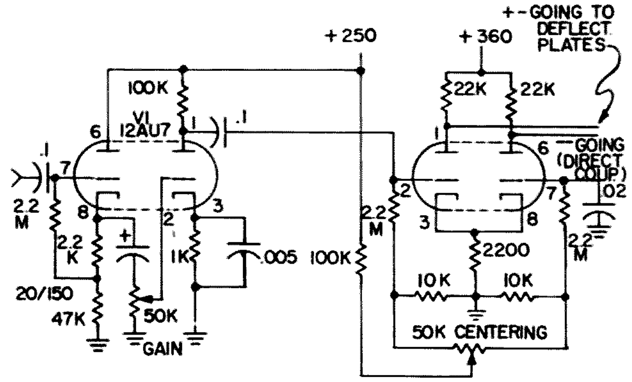


Fig. 1 Original OL-1 amp. circuit

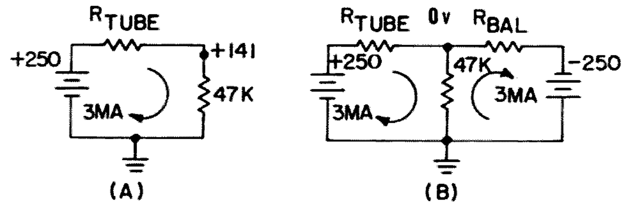


Fig. 2 Balancing input stage

:o an "artificial ground" and bypass the 2200-ɔhm cathode resistor, while retaining un-changed the operating conditions of the cath-ɔde follower. Fig. 2 shows in much-simplified form how it's done.

Fig. 2-A shows a representation of the ɔriginal conditions. The battery represents the +250-volt power supply, and R_{tube} includes the static resistance of the tube and any other resistors in the circuit except the 47K load resistor.

Under the operating conditions designed in-to the OL-1, approximately 3 ma flows in this circuit, and so the top of the 47K resistor (grid return point) is 141 volts positive to ground. The grid, also, is at this same voltage.

By adding a 250-volt negative supply to-gether with a balancing resistor, R_{bal}, also in series with the 47K resistor as shown in Fig. 2B, current flow in the part of the loop oper-ating from the negative supply can be adjusted to be exactly equal to that in the tube. The equal and opposite currents through the 47K resistor then cancel out, leaving no current at all flowing through it, so the voltage drop across it becomes zero. The top of the resistor s now at the same voltage as the bottom, or ground level.

However, when a signal comes into the tube the current flow undergoes change depending on signal; this upsets the balance and allows a voltage to develop across the 47K resistor. This voltage is the desired signal.

The original dynamic load on the cathode follower consisted of a 47K resistor shunted by a 50K gain control, or approximately 23K ohms. In the modified circuit, the load is 50K (gain control only) shunted by Rbal, which gain comes out to about 23K ohms. Thus operating conditions are not changed—but he stage is now capable of passing dc signals.

Lest visions of an additional negative pow-er supply frighten you, let me hasten to add hat semiconductor diodes make it simple. Fig. shows the schematic of the circuit I used; connections to the 6×4 rectifier already in the cope give both high-voltage ac and a dc source for the regulators. The VR tubes pro-vide ample filtering at the low current drain encountered here.

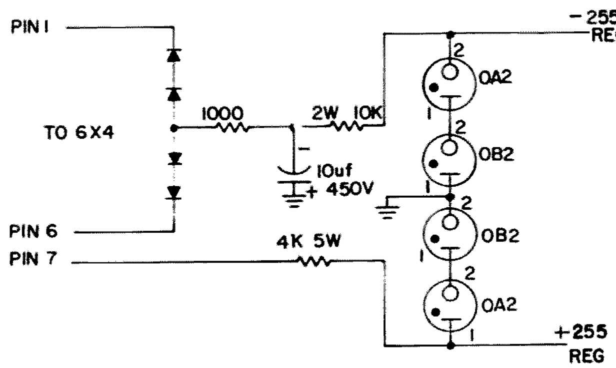


Fig. 3 Balancing power supply

Modification of the phase-inverter deflection driver stage requires a bit more physical work but is equally simple. In the original circuit, the grids are approximately 10 volts positive to ground; the centering control varies the rel-ative positive voltage on each grid to move the trace.

The plate potential of V1B is about 50 volts, which means that the difference between V1B plate voltage and V2A grid voltage is about 40 volts. Raising the cathode and grid voltages of V2 by 40 volts each will bring V2A's grid to the same level as V1B's plate, allowing the coupling capacitor to be eliminated.

This is easily done by changing the 2200-ohm common cathode resistor to 8600-ohms and rewiring the centering circuit. Fig. 4 shows the details. The grid of V2A is now clamped to about 50 volts by the direct con-nection to V1B plate, and centering is ac-complished by varying the positive voltage on the grid of V2B a few volts either side of the 50-volt level. The centering control was changed to 500K to allow a wider range; leaving the original 50K control in caused some distortion (due to limited available swing in V2) and a bit of warmup drift as the low-resistance control heated.

The completely modified deflection amplifier circuit is shown in Fig. 4; you can see that only four parts are changed, five removed, and one wire added. Now let's get down to the practical details of how to do it, step by step.

First, put together the power supply on a subchassis. Note that the 27K ½-watt resistor shown in the photos was later replaced with a 1-watt unit; the small one drifted badly dur-ing warmup.

Second step is to remove the scope from its cabinet. Then unsolder and remove from the printed circuit board the 47K cathode resistor for V1, the .1 mfd/200-volt coupling capaci-tor between V1 and V2, the 10K resis-tor in the grid circuit of V2B, and the 2200-ohm cathode resistor of V2. Disconnect all leads from the board to the vertical centering

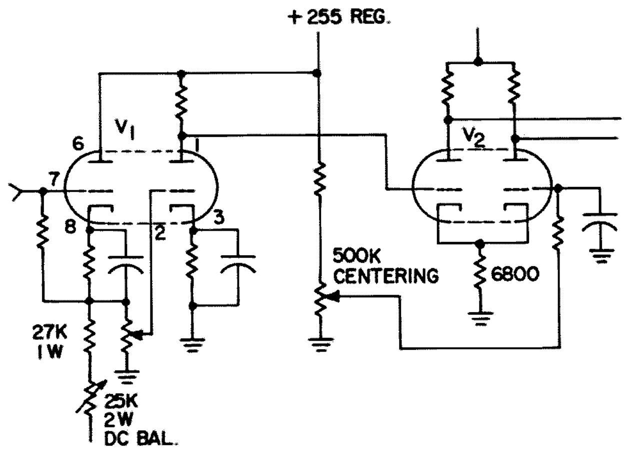


Fig. 4 OL-1 changed to dc amp. Parts not marked are unchanged

control, at the board, and locate the wire from V1's plate circuit back to the power supply. Cut this wire at the power supply.

Rather than remove the two resistors in the grid circuit of V2A from the board, I chose to cut the foil strip between pin 2 of V2 and the 2.2-megohm resistor. The break is shown in the photos; a sharp test prod is suitable for scraping the foil away from the board.

Now we start putting things back. Replace the cathode resistor of V2 with a 6800-ohm 1-watt unit, using existing board holes. The resistor will stand above the board surface but this doesn't matter. Replace the .1 mfd coupling capacitor with a piece of hookup wire soldered between the existing holes. Replace the vertical centering control with a 500K potentiometer, and ground the counterclockwise terminal of the new control. Run a wire from the other outside terminal to hole EE on the board, and from the arm to the hole nearest the 2.2-megohm resistor, left vacant by removal of the 10K resistor.

Replace the .1 mfd/400-volt input capacitor with a length of wire, and connect another length of wire from the junction between the negative terminal of the 20-mfd/150-volt capacitor and the gain control to the junction of the 2200-ohm and 2.2-megohm resistors in V1A's cathode circuit.

Install the power subchassis by removing two of the four transformer mounting bolts, placing them through the subchassis holes, and retightening them. Connect the subchassis leads to appropriate pins of the 6×4. Connect the 27K 1-watt balance padding resistor from the arm of the dc balance control on the subchassis to the junction of the 2.2-megohm and 2200-ohm resistors in V1A's cathode, and connect the cut lead from V1's power-supply circuit to pin 1 of the OA2 marked "+255 reg."

Set vertical gain of the scope to zero, recheck all wiring, cross fingers, and turn scope on. The two negative-supply VR tubes should light instantly. If they don't, turn it off fast and recheck for wiring errors.

The positive-supply VR tubes, however, will remain dark for about 15 seconds until the 6×4 warms up. After all four VR tubes light, turn the intensity control up and adjust vertical centering until the spot appears on the screen.

Switch horizontal sweep to any convenient frequency and adjust horizontal gain for a trace of about 2 inches. This is mainly to avoid any chances of burning the CRT face with a concentrated beam. Then center the trace vertically and mark a reference line on the screen to indicate trace position.

Advance vertical gain slightly; the trace will probably move either up or down the screen face. DO NOT RECENTER. Instead, adjust the dc balance control until the spot returns to the reference line. Then advance vertical gain all the way, keeping vertical input leads shorted to avoid hum pickup. Again, bring the trace to the reference line with the dc balance control. Now sweeping vertical gain quickly from full off to full on should result in no noticeable movement of the trace.

For best results, allow the scope to warm up thoroughly and repeat the balancing procedure described above. Balance should hold its adjustment then, providing only that the scope is allowed to warm up each time it is used.

If you prefer, the dc-balance control could be brought out as a front-panel adjustment either by drilling an additional hole or by using a concentric dual potentiometer for the new vertical centering control. However, I found that readjustment was not needed that frequently; a hole through the bottom of the cabinet, allowing screwdriver touchup occasionally, works nicely for me.

In using the modified OL-1, all controls operate exactly as before. Only one thing is different; since the scope now responds to dc, and panel space didn't permit easy installation of an ac/dc switch, the trace may shoot off the screen when you attempt to measure a waveform at a tube's plate. The remedy is to construct an ac probe, consisting of a .1-mfd/600-volt capacitor in series with the normal probe lead, to block the dc component of the signal when it's not wanted.

While at it, I installed a BNC connector for vertical input, but that's a simple matter having no connection with the main modification. I hope it works as well for you as it has for me.

. . . K5JKX

Carole Hoover Allen K9AMD/W5NQQ
171 Vermilion Drive
Lafayette, La.

The Missing Link

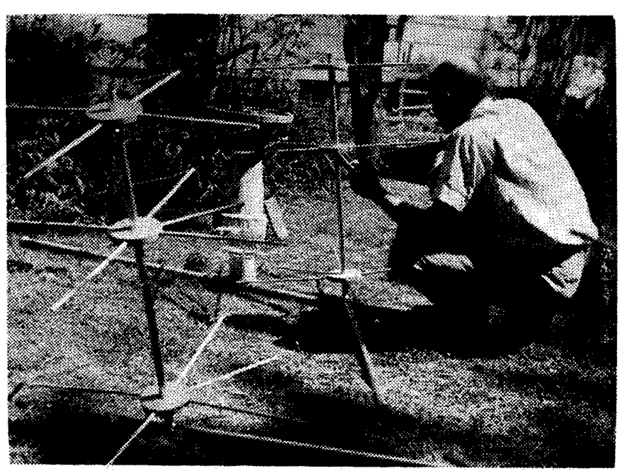
When my OM, Bill K9AKF, announced he was going to build the 2 meter Quad-Quad shown on Page 20 of the May '64 issue of 73, I was shocked! I had always thought that most hams read such spectacular schematics and diagrams like an XYL reading a recipe book—those baked Alaskas, bisques and Bavarians look fabulous, but who'd dream of trying one?

For those readers who may have missed the article, W8HHS built a fantastic 2 meter antenna consisting of four small cubical quads stacked broadside.

Well, when Bill read that the front to back ratio of the Quad-Quad exceeded 28 decibels, he forgot about lunch and a dental appointment and started gathering the needed materials.

The quad framework calls for thin-wall electrical conduit and the element supports are made from dowel rods. Acquiring these took only money, but the #10 copper wire for the elements was a different story. Neither the local stores nor the electricians could scratch up any #10, and for a few gloomy hours, it looked like Bill would have to swipe some from a phone company truck. Fortunately, the problem was solved without a theft when he thought of stripping some #10 house wire.

The next adventure came when he began cutting the wooden center hubs for each element. The only tool he had for the job was a small portable jig saw, and two hours of jigging produced what I guessed was a miniature egg-shape hexagon. Since my guess was wrong and there are twelve hubs needed, this job went to a wood-working friend-in-need.



Bill, K9AKF, assembles the bays of the Quad-Quad in the back yard.

When all the material was on hand, work began. Before long the basement was a jungle of dowels and hubs neatly spaced by wire. As each quad bay was tested successfully, excitement grew, and so did the size of the Quad-Quad. Completely assembled in the basement, it would have been another boat-in-a-bottle deal, twice as big as the door. But, Bill had thought of that and wisely decided to re-locate in the back yard.

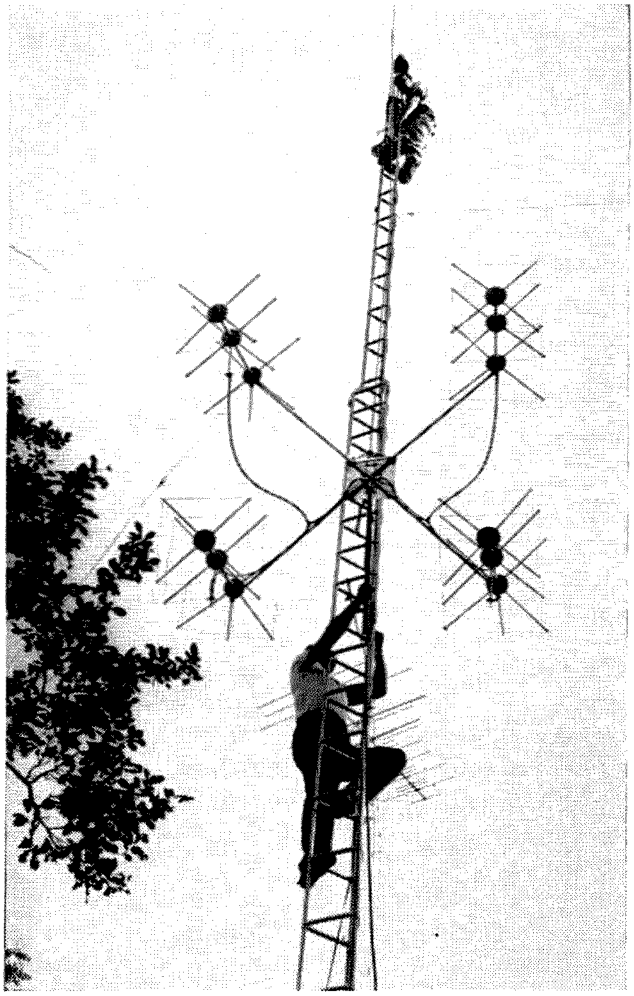
Next came the assembly of the bays on the framework and the wiring of the harness. Even in the hot June sun, work went well, and the wires were wonderful for drying nylons when his back was turned.

Now, I mean no criticism of W8HHS's fine article, but it does skip hurriedly from *The Tune-Up* to *The Performance* completely omitting an interesting phase known as *The Installation*. It is upon this missing link we will now dwell.

When the Quad-Quad is assembled, it reminds one of a wind-mill, and this is good since all hams seem to feel that the bigger an antenna is the better it is. The only time he wishes it was the size of a toothpick is when he is climbing to the top of his 70 foot tower swaying in a stiff wind with three or four nervous relatives milling helplessly below, and the beam hanging on a rope somewhere in between.

Bill chose a quiet evening for the raising of the Quad-Quad and climbed the tower trustingly placing its welfare in the hands of his XYL (me), and his in-laws, K9AXS Golde, and W9VEY Dan. The gals would guide the elements while Dan pulled on the hoisting rope.

All went well for about the first 10 seconds. At that time, a dowel tip hit the bird bath and bent a bit. This was quickly fixed, but as the quad was pulled toward the eaves, one bay seemed magnetized by the branches of our plum tree and became entangled. Panic struck. I climbed up the tower a few rungs to



Frank, K9HYZ, guides the Quad-Quad up to K9AKF after the disastrous plum tree episode.

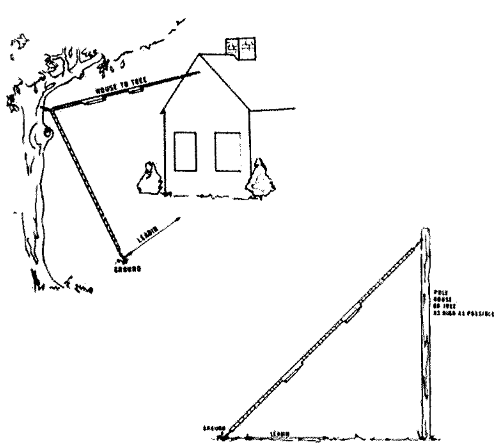
steady the quad and managed to catch the opposite bay on the corner of the house. K9AXS ran for the rake to push the elements free, and W9VEY dropped the rope to help his women leaving Bill at the top of the tower with the weight of the Quad-Quad on the rope.

The sickening sound of cracking dowels followed; the quad broke free; Bill came down, and we talked him out of starting a dowel rod bonfire on the spot. Later in the evening, an inventory revealed only minor damage, and it was decided to try, try again.

Two nights later, W9VEY pruned his prize plum tree 'til it looks like a poplar; Frank K9HYZ, climbed on the roof to guide the Quad-Quad, and up it went like Santa through the chimney.

We have found the performance of the Quad-Quad as terrific as Doug De Maw's claims. DX contacts have been made; reception remarkably improved; and, yes, the front to back ratio must be 28 decibels at least!

. . . K9AMD



Mosley's "El Toro"

Howard S. Pyle W7OE
3434-74th Ave., S.E.
Mercer Island, Wash.

They say "there is nothing new under the sun." Well, I found something which really opened my eyes; a three-band, trap-type, grounded quarter wave antenna using an unusual tuning method which, in effect, makes it an "automatic band-switching antenna."

Designed for the 20, 40 and 80 meter bands as well as a type for the novice 15, 40 and 80 meter domain, the whole assembly is only 58 feet long over-all and weighs but two pounds! Furthermore, it can be erected as a vertical, or as a combination vertical and horizontal and can be bent or "drooped" as necessary as much as 45 degrees to reach the ground termination! Or, it can be installed in a sloping position for it's entire length; truly a versatile antenna adaptable to almost any space or location!

Initial tuning is accomplished by a series of shorting bars and two capacity tuners. These can be adjusted to resonate in the middle of all three bands or right on your generally used frequency in each of the bands without further adjustment after erection. Tuning is sufficiently broad to provide high efficiency as well as extremely low SWR ratio at all other points in each band.

Such an antenna, known as "El Toro", is manufactured by Mosley Electronics, well and favorably known to most hams by reason of their excellent beam antennas, thousands of which are serving amateurs all over the world. This novel antenna is offered in three types; the NS-3 Novice Special, pre-tuned to the novice portion of the 15, 40 and 80 meter bands with a power handling capacity of 300 watts; the TW-3X Jr., for 20, 40 and 75/80 meter operation at 300 watts CW-SSB, 1000 watts to final amplifier and the TW-3X rated to handle the maximum legal limit of 1000 watts input to the amplifier, SSB-2000 watts PEP.

Any of these antennas can be either roof or ground mounted; slightly superior performance is realized with ground mounting; merely a good connection within a few inches of ground level is required and, in most cases, no radials are necessary. A driven ground rod or a convenient water pipe or conduit will generally prove to be an adequate ground. Roof top mounting will require a few radials except where mounted on a metal roof.

All antennas are supplied in kit form, with detailed assembly and erection instructions and with all of the "hard work" accomplished at the factory. The radiating portion comes completely assembled with all spreaders in place and all of the machine work done on the tuners. In spite of this, the complete antenna is shipped in a small, light weight carton only twenty inches long and about six inches square! Everything is supplied including end insulators; you need only assemble the ki which takes but a few minutes, solder the small shorting bars in place, connect the two tuners as shown in the instructions and hois the complete antenna into the air. You need furnish nothing but a sufficient length of 52 ohm co-axial cable to reach the transmitte from the ground end of the antenna (actual length is not important although the shorter the co-ax feed-line, the less loss and bette SWR), a short piece of nylon rope or clothesline . . . plastic clothesline will serve as well . . . with which to tie the end insulators to the antenna supports, and a good ground connection.

In effect, the antenna is a 450 ohm, open-wire feed line which comprises the entire *radiating* portion. The writer has experimented with scores of antennas over a period of many years and has found the Mosley "El Toro" to be the equal of any of those which he has used. And, at the cost, unless your 'piggy-bank' is awfully low, it will pay you to buy the Mosley kit rather than try to duplicate it by 'home-brewing'.

. . . W7OE

Letters

The Monitor Magazine (cc to 73)

Dear Joe,

In a recent form letter from John Huntoon requesting my reconsideration to re-join ARRL I see ARRL now lays claim to the success of the Goldwater Reciprocal Bill. Frank Mortensen W7HNT and I can tell you of the *many* negative replies from ARRL officials and legal representatives during the period prior to 1962. The mess that is resulting from their proposals for incentive licensing will not immediately stop. With all the opposition shown to date one would think that ARRL would reconsider their initial moves and review the matter for the good of all amateurs in full membership. Since it is apparent that they do not intend to do so, nor do they intend to adapt a democratic policy in the representation of the amateurs, the only solution appears to be the development of providing the ARRL with stiff competition in the form of another organized amateur body, one that will truly represent their members. The IoAR has already proven what another amateur radio group, although small in membership, can accomplish during its short life. If you and other editors would get with the officials of the IoAR in strengthening that new group I believe that it could be done.

John F. Barrows DL4HU

ARRL, Newington, Conn:

You will find from your records that I am no longer a member of the ARRL, nor will I be as long as the present policy of said group continues. I have a slogan of my own: Amateur Radio is going to Hell because we trusted our fate to the ARRL.

George Walker W7GCO ex-E.C.
Pocatello, Idaho

Dear Wayne,

I have received several letters concerning my article on alternators. The main question is how to eliminate alternator whine—particularly in two meter rigs. I've checked around and the best results are obtained by placing a pi filter in the filament lead or in the line from the battery. Evidently the AC from the alternator gets past the rectifiers and the battery to the filaments, and into the rig.

I would like to add to the long list of true ham experiences one of my own. On Friday the 13th, last November, a large portion of my home burned. What the fire and smoke didn't get the firemen did. However, enough remained, providing we didn't mind sleeping on the floor and not changing clothes. The next day—Saturday—I decided to rent a house across the street that had been vacant several years, and in West Texas, that means full of dirt.

The word got out that I was going to move that afternoon, and in large masses the hams began arriving at my once proud QTH. They cleaned the new house from top to bottom, the gas, water, and electricity were turned on (Saturday afternoon, no less), washed up the terribly smoked furniture, and moved it across the street to the new house! The amazing part of this fact is that it was accomplished in about an hour and twenty minutes. I estimate that 45 hams participated in my move.

The results of the fire are still quite evident, the furniture *still* smells of smoke, the XYL is *still* in the hospital recovering from burns received in the fire, but this will soon pass and be forgotten. However, I will never forget the friendliness of the hams that appeared that Saturday afternoon.

O'Kelly W5VOH
Midland, Texas

Dear Wayne:

Hmmm—that's strange: Seems I recall reading in one of CQ's editorials that one of the reasons for their dropping of Clif was that he wanted to print two to three pages of call letters. That's it! I knew there was something missing from their November issue. Sure enough—*their* four pages of call letters for *their* awards were saved for the next month (and, of course, a more unrelated editorial,) instead of the usual November issue. Nothing like following your own creed.

Jim WϕDSU

Dear Wayne:

Congratulations on the "ALC for SSB" article in the 1-'65 73. As Kyle points out, there has been very little written on such an important SSB subject, mine (CQ April '61) and two other references. I was about to write an article myself to bring things up to date and out in the open. One thing that I have never understood is that my material was written and submitted to the two amateur radio publications of the day five years before I finally got it published in the SSB column! There is a recent excellent reference that covers all phases of SSB, "Single Sideband Principles and Circuits" by Pappenfus, Bruene and Schoenike (Collins engineers) McGraw-Hill, and especially their chapter on "Signal Processing for SSB Transmission." Besides all of the dope on ALC they point out that AF clipping can be used with SSB, an argument to the contrary often used by the die-hard AM/DSB boys to "prove" some advantage for that ancient mode.

In adding ALC to the HT-32, recent experiments show that the ALC voltage should be applied to the grid of V2 (pin #1) and not the grid of V5 as shown in my article and mentioned by Kyle. There is a fixed negative bias on the grid of V5 and the ALC voltage would be in parallel with it, causing a delayed action. Kyle made a little slip when he referred to testing the ALC action with an audio oscillator. He should have said to use a two-tone audio oscillator as a single tone or carrier will not actuate the ALC.

Regarding the letter on 6DQ5's by W6ZGZ and the article to which it refers. I never could see why all the concern with brands of 6DQ5 tubes when there are a number of TV tubes that are better for RF Class AB1 amplifiers. The best tube that I have found is the Tung-Sol 8236. My check shows that it gave some 18% more output than the equivalent TV tube types at the same input. I am running a cool pair at 500W PEP input in my HT-32X and have been wondering why I never saw any mention of these fine little bottles.

Wayne W. Cooper K4ZZV/W6EWC

Dear Wayne:

Just want you to know I am making constant use of the gratis copy of 73 magazine you are sending me.

I am constantly reading appropriate articles on the 2 hour "RADIO DIGEST" tape distributed by Science For The Blind.

The last report I received some months ago our circulation was nearing the 100 mark. This means that these blind hams and would-be hams are receiving material they otherwise would miss!

With the co-operation of 73 and other ham magazines my expense is reduced. I furnish and maintain my own equipment and some supplies but am spared the expense of the magazine subscriptions.

Thanks again, Wayne, for myself and for all my sightless listeners.

Henry G. Kuhn W2IRU

Howdy Wayne,

The Ham Radio Commemorative Stamp is hideous. It shows a *modulated* wave form, a few bolts of lightning and is a sickly purple. A modulated wave form doesn't represent CW. I'm a CW man. QST is a CW magazine. Did somebody drop the ball *again?* It would be interesting to know just what came off here.

Thomas Turner K8VBL/6
Oakland, California

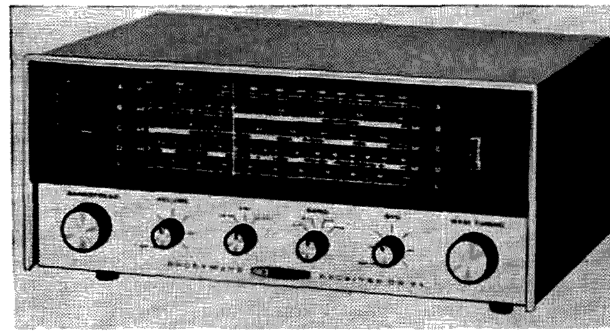
Four Armed

Editor CQ Magazine:

In August of 1964 I sent 104 QSL cards to Mr. Urban Le Jeune Jr., W2DEC, Box 35, Hazlet, New Jersey 07730 by registered mail. In October I received Certificate #404 for contact with 100 countries on SSB. On November 10, 1964 I requested the return of my cards in an air mail note to Mr. Le Jeune. Since I have not received the cards nor any reply to my letter, I can only assume that I have been cheated out of my cards and the $1.00 that I sent in to cover the return postage by the irresponsibility of Mr. Le Jeune and CQ Magazine.

W. E. Hughes Jr. XE2WH
Monterrey, Mexico

The New Heath GR-64 SWL Receiver



Donald Smith W3UZN
Kent Mitchell W3WTO

If you are like the usual ham you enjoy listening to your favorite amateur band as much as possible. However, monitoring the local gang or keeping a lookout for band openings is not always convenient. When you're working in the basement shop or in the garage you're often not within audible range of the shack. The obvious solution to this problem is to get a second receiver. Duplicating the expensive receiving gear you have in your shack would be economically unwise, so a search for something less costly is in order. Consider then, the Heath GR-64 receiver kit.

This receiver certainly fulfills our desire to keep cost down. It offers many desirable features besides. (Over 100,000 other people have thought so too, as indicated by Heath's sales records.) The GR-64 has a standard broadcast band which other members of the family may listen to when you are not receiving on the ham bands. Frequency coverage is 500 kc to 30 mc.

The receiver uses a 12BE6 in the converter to produce a 455 kc *if*. A 12BA6 *if* amplifier stage not only amplifies the 455 kc signal, but functions as a beat frequency oscillator as well. Detection is performed by a 12AV6 and a 12AQ5 amplifies the audio to drive the built-in 5" round speaker or ear phones. Power is provided by a transformer operated power supply using silicon diodes in a full-wave doubler-rectifier circuit.

Although the receiver has no rf amplifier stage, direct comparison tests with a well-known $450 receiver were surprisingly good. Alternately using the same antenna on both receivers, almost all signals heard on the higher priced model were heard on the GR-64. Selectivity seemed to be the main difference. An outdoor long-wire antenna is recommended for best results.

A large etched circuit board and uncrowded chassis lay-out make construction easy. Assembly time is approximately 14 hours.

Features of the GR-64 receiver include an "S" meter, a large slide-rule main tuning dial, a bfo, and provisions for an external Q multiplier. The all steel cabinet is finished in a gray wrinkle with an attractive silver trim. The front plastic feet on the bottom of the cabinet are slightly longer than the rear feet, so the receiver sits at a jaunty angle that makes tuning easier.

All things considered the Heath GR-64 is a good buy.

GR-64 Specifications

Frequency Coverage	550kc to 30mc (in four bands)
Circuit	Superhetrodyne
Controls	On-Off/Volume, Band Switch, Main Tuning, Fine Tuning, bfo, ANL (Noise Limiter) Mode Selector (AM-STBY-CW)
Tube Complement	12BE6 Oscillator and mixer 12BA6 if amplifier and bfo 12AV6 Detector and audio amplifier 12AQ5 Audio output
Antenna Impedance	High Z
Power Supply	Transformer operated, silicondiode in a full-wave-doubler circuit
Power Requirements	117vac @ 30 watts
Dimensions	13½" wide x 6" high x 9" deep
Weight	11½ lbs.
Price	$39.95

. . . W3UZN
. . . W3WTO

73 Books

Peterborough, N.H.

Marty Feeney, Jr. K1OYB

IQ Test

Are you kept off the air because of TVI? Is your puny 25 watts drowned in the vast wasteland of 20 meter QRM? Does your rig suffer from tired blood? In short, are you somewhat dissatisfied with amateur radio? Relax, then. This article won't solve all (or any) of your problems, but it will give you an enjoyable few hours.

There are five ham shacks, each of a different color. Each of the operators runs a different rig, each belongs to a different organization, and each reads a different magazine. Below are certain facts about each of these hams. By proceeding in a logical manner, you should be able to determine the answers to these questions:

1) Who reads "Playboy"?

2) Who belongs to the "Munjoy Hill Society for the Preservation of Spark on the Eleven Meter Band"?

Note. The relationships described need not ecessarily be reasonable. For example, the X'er may or may not belong to dxcc, the lid doesn't necessarily read CQ, etc. The houses are in a straight line, numbered from left to ight.

1) There are five ham shacks.

2) The lid operates from the red ham shack.

3) The DX'er reads CQ.

4) The operator in the green ham shack belongs to DXCC.

5) The VHF'er belongs to ARRL.

6) The green ham shack is immediately to the right of the ivory one.

7) The owner of the DX-20 reads QST.

8) The ham in the yellow shack operates a Communicator II.

9) The operator in the middle house belongs to the IoAR.

10) The ham in the first house is a RTTY'er.

11) The ham who operates the home-brew rig has his ham shack next to the ham who reads 73.

12) The "Proceedings of the IRE" are read in the ham shack next to the ham shack where the Communicator II is operated.

13) The operator of the KWM 2 belongs to the Certificate Haters Club.

14) The Rag-Chewer runs an ARC 5.

15) The RTTY'er built his ham shack next to the blue one. . . . **KIOYB**

Answers on p. 78

Understanding the Schmitt Trigger Circuit-

Jim Kyle K5JKX
1236 N.E. 44th St.
Oklahoma City, Okla.

Recent publication of RTTY converters built around "Schmitt Trigger" circuitry has revealed, through reader response, that many of us hams don't know very much about this exceptionally useful circuit, and consequently can't follow our usual practice of cut-and-try modification.

Which is distinctly not a good state of affairs, because the Schmitt Trigger is one of the most versatile and useful circuits ever devised outside the basic amplifier stage! It can act as a peak clipper to provide virtually infinite clipping; it can convert sine waves into square waves should you need them; and it is especially useful for RTTY converters because it combines several functions into a single stage.

Essentially, the Schmitt is a regenerative switch which flips on or off in a matter of microseconds (or even fractions of a microsecond when so designed) yet will remain on so long as the input signal tells it to.

It's a variant of the general family of multivibrators; the characteristic which makes it unique in the family is that it doesn't "vibrate" like all the rest. The routine multivibrator of the free-running variety oscillates continually, the "mono-stable" or "one-shot" delivers a single timed output pulse for each input signal applied, regardless of length of the input signal, and the "bistable" or flip-flop alternately turns on or off. Only the Schmitt exhibits the relay type of operation by remaining on so long as input is present.

Unlike the mechanical relay, though, the Schmitt can operate nicely up in the megacycle range. It has negligible time delay between input signal and output action, and similarly small delay between removal of input and "drop-out." To boot, it's a high-impedance device which can be connected almost anywhere without loading down the driving source, and it automatically provides an "inverted" or "reverse" output as well as its normal output.

The output is a voltage at one of two levels; the upper level is equal to the supply voltage (when the Schmitt is not loaded down by the following stage) while the lower is determined by the trigger design but is usually much much lower. A low-voltage level of about 50 volts is typical for vacuum-tube Schmitts; something well below 1 volt is typical for the transistor version of the circuit.

These output levels hold true regardless of the input level. If input signal is large enough to trigger the circuit, output rises to the upper level and stays there. If the input signal is not large enough to trigger, the output remains low.

At the "inverted" output terminals, conditions are reversed. Voltage is at the lower level when the circuit is triggered, and goes high when the input signal is absent.

These characteristices make the Schmitt a perfect clipper, since any signal above the trigger point will produce an output of known level. Signals below the trigger point don't get through. It also is a wave-squarer, since the trigger point can be set at virtually zero volts. For half of a sine-wave input, the trigger is on, and for the other half it's off. The output, consequently, is a square wave.

And since a 2-volt change in input level can cause a 150-volt change in output level (in the vacuum-tube version) the Schmitt turns out to be a pretty good amplifier as well. Thus in RTTY it can combine the functions of limiting, inverting for "bilateral" copy, and amplifying the teletype signal all in one stage. Th transistor version is even more sensitive, producing a change in output of some 10 volt with an input variation of only 0.01 volt. Thi equals a gain of 1,000 times through the stage, with limiting action thrown in.

To see how it works, take a look at Fig. 1. This shows a typical vacuum-tube Schmit Trigger circuit, with all circuit component identified. A bit farther on we'll find out ho to determine proper values for all these things.

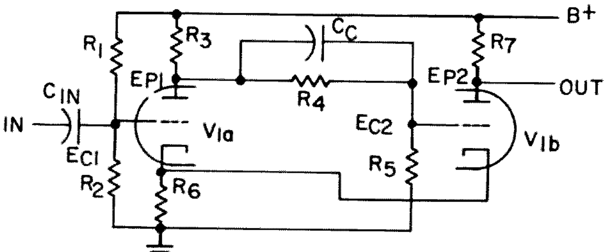


FIG. I VT SCHMITT

First let's assume that one of the two triode sections is at zero bias, and conducting as much current as the tube and its plate resistor will allow. Don't worry about the effect of R6, the cathode resistor, because it really doesn't have much to do with the amount of current which flows.

However, the voltage across R6, or Ek, will be equal to the current times the value of R6 in ohms. Let's make sure this amounts to enough volts to completely cut off either triode section; how much this will have to be can be determined from a glance at the tube handbooks.

Now let's adjust the relative value of R1 and R2 to fix the voltage at V1a's grid, Ec1, right at cutoff. Remember that cutoff voltage is measured between grid and cathode, and the cathode is positive to ground by Ek volts. Therefore, Ec1 should be equal to Ek minus the cutoff voltage (all voltages expressed as positive numbers).

This ensures that V1a is cut off, and no current passes through the tube. With no current flowing, the plate voltage Ep1 should rise to the same level as the supply B +. If it were not for the shunt path to ground made up of R4 and R5, this would indeed be so, and if and R5 are both large compared to R3 the difference between B + and Ep1 will be small indeed.

The grid of V1b, though, is connected to the junction of R4 and R5, and so is receiving a fraction of the plate voltage of V1a. The exact value of Ec2 under these conditions is determined by the ratio of R5 to the total of R3, 4, and R5, and can be made almost anything desired. For most positive and sensitive action, Ec2 under these conditions should be set about ½ volt positive with regard to Ek. That is, if Ek is 10 volts, Ec2 should be 10½ to 11 volts.

Remembering that the effective bias is measured between grid and cathode, with the grid at Ec2 and the cathode at Ek, the effective bias on V1b will be about ½ volt positive. This locks V1b into conduction, which establishes our original assumption and assures us at Ek does really exist.

Since V1b is conducting as heavily as it is able, its plate voltage Ep2 will be comparatively low. The exact value of Ep2 under these at-rest conditions will be equal to Ek plus the plate-to-cathode voltage of V1b as determined by a load-line plot on tube curves. The calculations aren't really necessary, though; the value is normally less than 50 volts and with a bit of luck you can find as little as 15 volts at the plates.

So far, we've established only the "resting" condition of the circuit, and shown how Ep1 is maintained near the supply level while Ep2 is near ground in the absence of input signal. Now let's look at what happens when a signal comes in through Cin.

If the signal happens to be going in the negative direction, it will only bias V1a deeper into the cut-off region and nothing at all will happen.

However, if the signal is going positive, it will reduce the bias on V1a. As bias is reduced (by reducing the difference between grid and cathode voltages) the plate current will increase from zero. This will in turn reduce Ep1 by increasing the drop through R3, and the drop in Ep1 will in its turn reduce the value of Ec2. At the same time, Ek is increasing very slightly due to the current flowing through V1a, and the drop in Ec2 together with the rise in Ek moves the bias on V1b from its slightly-positive point back to zero and then on into the negative direction.

As the grid-to-cathode voltage of V1b becomes more negative, its plate current decreases and this in turn tends to make Ek slightly smaller, cancelling out the earlier increase. The reduction of Ek reduces bias on V1a still more, which allows more current through R3 and in its turn increases the bias on V1b. If the input signal remains at this level or continues to go positive, the cumulative effect of the changes in bias will be a "flip" of conditions to the opposite of those existing at rest. V1a will be conducting because of the input signal, and V1b will be cut off because its cathode is more positive than its grid. The output, Ep2, will rise to the supply value, while the "inverted output," Ep1, drops to the same low value which existed at Ep2 previously.

The whole operation described above takes place in a matter of microseconds; capacitor Cc steepens the voltage change at Ep1 as seen by V1b's grid, to speed up operation even more. And once triggered, the circuit remains in this state so long as the input signal remains above trigger point. Additional increase in input signal has no effect.

The circuit can also be made to operate just exactly opposite to the manner described, so that V1a conducts in the "at rest" state and turns off when a negative-going input signal arrives. The only difference is that for this type of operation, Ec1 is set so that it is just slightly positive to Ek.

In practice, R1 and R2 are usually made up of a potentiometer (frequently with limiting resistors at each end) so that Ec1 can be varied over a range wide enough to allow either type of operation. When this is done, a 1-megohm resistor is connected between the potentiometer arm and the grid of V1a to maintain isolation of the signal and the biasing voltages, and Cin connects directly to the grid.

Note that the absolute sensitivity of the VT Schmitt is determined primarily by tube choice and next by the value chosen for R6, the common cathode resistor. Tubes requiring little voltage to cut off make the most sensitive Schmitts. The amount of voltage necessary to trigger the circuit will always be at least as much as the swing from zero to cutoff on the tube. The value of R6 will in turn determine the ratio of R2 to R1 + R2, to set Ec1, and the ratio of R5 to R3 + R4 + R5, to set Ec2. R3 and R7 should be equal, and should be chosen to obtain maximum voltage swing between "on" and "off" states while not requiring excessively high values for R4 and R5. The sum of R4 + R5 should be at least 10 times the value of R3.

Inability to make a Schmitt do its triggering may be due to a wrong ratio between R4 and R5, or to too high a value for R6. However, R6 must be large enough to ensure cutoff of the "off" tube with the current available.

Occasionally, if the values of R1 and R2 are far out of line, you can find a situation where the thing won't trigger but it *will* turn V1b on and off. In this case, V1a is acting only as a class A amplifier to drive V1b as a switch, and the intended regenerative switching action is lost. The remedy is to adjust the values of R1 and R2.

So much for the vacuum-tube version. Now let's look at its transistorized equivalent.

This circuit is shown in Fig. 2, and the similarity is apparent. The major difference is that our switching factor now is base injection current.

With no base injection current, a transistor remains cut off and collector voltage is equal to supply voltage. If enough base current is supplied to "saturate" the transistor, collector to emitter resistance drops to less than one ohm and collector voltage becomes effectively the same as that at the emitter.

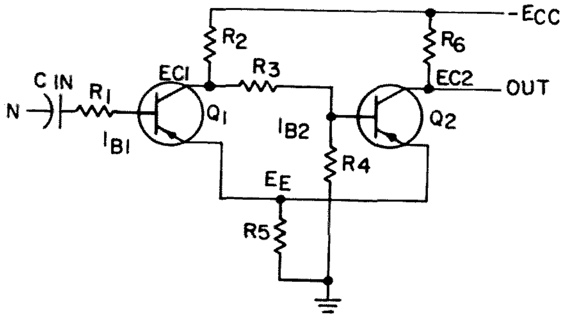


FIG. 2 TRANSISTOR SCHMITT

In the circuit of Fig. 2, with no input signal, Q1 receives no base current and so is cut off. Q2, on the other hand, receives base current through the series combination of R2 and R3. R4 bleeds off excessive current to ground, to prevent oversaturation of Q2. With Q2 saturated, the current through it is limited only by R6 and R5, and a definite emitter voltage (Ee) is developed by this current through R5.

This emitter voltage reverse-biases the emitter-base junction of Q1, which helps hold Q1 even more firmly cut off and maintains the input impedance of the circuit at a high value.

When a negative-going input signal greater than Ee comes in through Cin, the emitter-base junction of Q1 becomes forward biased and Q1 is no longer cut off. With Q1 conducting to even a small degree, the current through R2 has two paths to follow instead of merely one and thus the current through the R3-R4 path is reduced. This reduces the base current available for Q2, thus reducing the current flow through Q2 from collector to emitter. When the current flow drops, the current through R5 falls accordingly and Ee's value becomes less. Reduction of Ee by this action increases the amount of forward bias on Q1, which allows more current to flow through Q1 and in turn reduces the base current of Q2 still more.

Since this action is regenerative, the base current of Q2 rapidly drops to zero. Q1, by this time, is in saturation and Ec1 is only slightly greater than Ee. With no base current in Q2, this transistor is cut off and Ec2 rises to be equal to the supply voltage.

The situation persists as long as the input signal is present. Upon removal of the input signal, Q1 ceases to conduct and the base curcurrent available for Q2 drives the second transistor from cutoff back into conduction, restoring the "at rest" conditions.

Since the voltage difference between base and emitter required for cut-off is on the order of only millivolts, rather than being in volts as with tubes, the transistor Schmitt is much more sensitive than its tube equivalent. In addition, since no grid-bias network on the input section is necessary, fewer parts are required.

These two dfferences make the transistor type more attractive for many applications. The only real disadvantage is the requirement for a negative power supply; a secondary item which might be considered a disadvantage is the inability to switch from negative-going to positive-going trigger input.

However, should triggering from positive-going signals be a requirement, it can easily be achieved by simply switching from the PNP transistors shown in Fig. 2 and using NPN types instead. Then the power supply would be positive in polarity also.

Adjustment of trigger voltage level is accomplished by varying R5, which typically is a 500-ohm potentiometer connected as a rheostat.

To design a transistor Schmitt, R2 and R6 are chosen to limit transistor current in the "on" or saturated condition. They should be equal in value. R5 is chosen for the desired trigger-voltage point, so that about ½ volt less than desired triggering is developed with the design current flowing through it.

Next, R3 is picked to deliver enough current to the base of Q2 (with Q1 disconnected) to ensure saturation of Q2, and R4 is then chosen to bleed off just enough of this current to prevent over-saturation. An empirical design technique is to make R3 10 times as large as R2, then use a pot for R4 and set it so that the voltage measured at Ec2 (with Q1 disconnected) is just barely higher than that at Ee. If R4 is too small, Ec2 will be too high; if R4 is too large, a small time delay may be introduced in the trigger action.

This procedure fixes all the resistor values except R1. This is a current-limiting resistor to protect Q1, and should be about 1,000 ohms for every volt of peak input signal expected.

A transistor Schmitt circuit published by General Electric uses the following values with type 2N396 transistors (PNP) supplied from a 12-volt Ecc: R1, 4700 ohms; R2 and R6, 1800 ohms; R3, 18K ohms; R4, 15K ohms, and R5, 560 ohms. This set of values switches at –5 volts signal input, and holds in until the signal rises to –2 volts. Output levels are –4 and –12 volts.

Another circuit developed at General Precision, Inc., uses type 2N1302 NPN transistors and a + 20-volt Ecc. Values for this one are R1, 4700 ohms; R2 and R6, 1500 ohms; R3, 18K; R4, 15K; and R5, 0-500 ohm adjustable. Input voltage ranges from 1 to 6 v rms, and

the circuit can trigger on a 0.01-volt change in input level. Output levels are not specified.

Still another circuit, from G-E and using type 2N78 NPN units with a + 12-volt Ecc, uses these values: R1, 1K; R2, 3300 ohms; R3, 1800 ohms; R4, 6800 ohms; R5, 5600 ohms, and R6 2200 ohms. Turn-on point is at 6.8 volts input, and drop-out occurs when the input signal falls to 5.2 volts. Output swing is only from 12 to 10 volts as a result of the high resistance value at R5 and the lower value of R6 (as compared to R2). However, this circuit was designed to operate at 1 mc, a rather high frequency for transistor Schmitts. The other circuits described operate well up to 500 kc but begin to fail above this point.

Now that we've seen how the Schmitt works, let's see how it can be used in practice. Let's assume that we want to limit the audio output of a receiver to a definite value, say for CW reception.

A transistor Schmitt, using the circuit of Fig. 2 and the parts values given for type 2N1302 transistors, but using 2N107's or better yet 2N404's instead (with consequent − 12 volt Ecc instead of + 12) will do the trick. Simply connect Cin to a phone plug and plug it in in place of your phones. Connect the phones, then, across R6, either with or without a blocking capacitor in series.

Any input signal will be squared off top and bottom by the Schmitt, giving the same level of output. Because of the amplification provided by the Schmitt in addition to its limiting duties, you can run the receiver gain controls far enough down to have little trouble from QRM or QRN. However, the gain controls won't affect the loudness of the signal in the phones. To reduce the signal somewhat, reduce Ecc (with a potentiometer across the battery if you like).

The fact that you're listening to a square wave instead of a sine wave won't be particularly bothersome; the note will sound "richer" but will otherwise be unaffected. The difference will be that now the kw down the block won't be any louder than the weak YC4 you're digging for!

For RTTY, the Schmitt can be used the same way as a limiter ahead of any conventional TU. Even better use for the Schmitt's peculiar properties can be made by designing a TU around it; this was done in the "Errorless" converter described in these pages some months ago.

In a fone transmitter, a Schmitt can replace the conventional biased-diode clipper to produce virtually "infinite" clipping. Some experimentation may be necessary, though, as no control of clipping depth would be possible.

An audio-frequency direct-reading frequency meter can easily be built around the Schmitt, since it converts incoming sine waves to square waves. The frequency can be determined by differentiating these square waves through a short-time-constant RC network, then using the narrow spikes to actuate a microammeter. Deflection of the microammeter needle will be directly determined by the frequency at which the spikes appear, which in turn is determined by the frequency of the sine wave input.

And if you like to test audio equipment with square-wave input, a Schmitt between your sine-wave oscillator and the audio gear will give you the square waves at any frequency you like.

These are only a few uses of the Schmitt. Some others depend on the fact that the output load resistor, R7 in Fig 1 and R6 in Fig. 2, need not necessarily be a resistor.

If a relay coil is substituted, the relay will operate every time the output half of the stage conducts, and will release the rest of the time. Thus a 10-millivolt input level change can be made, through the Schmitt of Fig. 2, to operate a relay which in turn operates a heavy-duty contactor to turn on or off a multi-kilowatt power supply. How about this for overload protection of your final, in conjunction with a cathode resistor across which a control voltage for the Schmitt would be developed?

Similarly, a loudspeaker coil may be used in place of the output resistor; with normal tubes or transistors, you'll get plenty of volume. Using phones here will probably give far too much sound for even the deafest of us.

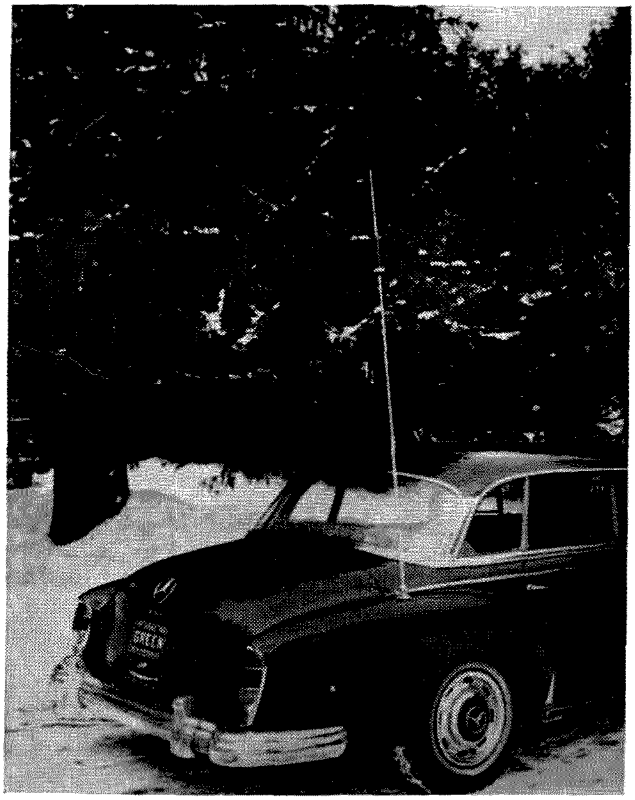
At any rate, the usefulness of the Schmitt circuit is limited only by your imagination and by your understanding of how the circuit works. We've tried to help in the latter department. The former is up to you!

. . . K5JKX

Answers to IQ Test on p. 73

Shack 1	Shack 2	Shack 3	Shack 4	Shack 5
RTTY	VHF	LID	DX'er	RCC
YELLOW	BLUE	RED	IVORY	GREEN
COMMUNICATOR II	PROCEEDING OF THE IRE	IoAR	CHC	DXCC
73	ARRL	DX-20	KWM-2	ARC-5
M.H.S.F.T.P.O.S.O.T.E.M.B.	HOMEBREW	QST	CQ	PLAYBOY

73 Tests The Waters Mobile Whip and a Mercedes 300

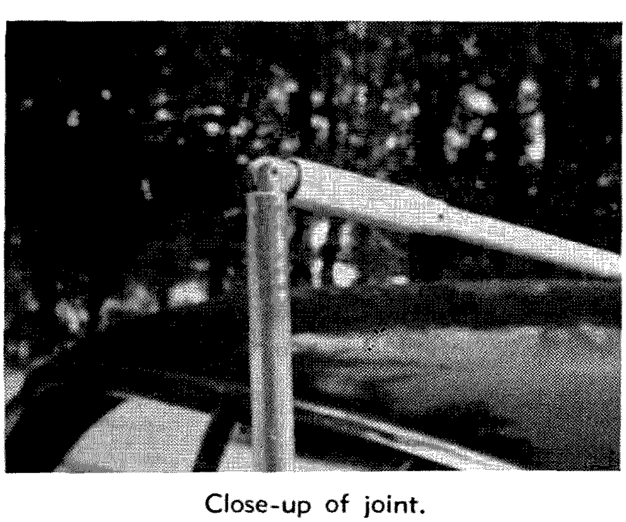


Wayne Green W2NSD/mobile 1

Those of you who have been following my mishaps down through the years know that along in 1957 I discovered the Porsche. Well, I've still got my original Porsche and it is a lot of fun, despite a bookful of difficulties with the factory and their dealers. But somehow, up here in New Hampshire where the distances are far and the weather is cold half of the year, it seemed prudent to go for something sedanish, with perhaps some room for a rig.

A Mercedes 300 seemed to best fit my retiring personality, so I inveigled the bank into buying me one. One of our advertisers had a special on SB-33's. After some wheeling and dealing I ended up owning a 33 and still had a little of 73 left in my name.

Waters Manufacturing had just recently announced their new mobile antennas so it seemed reasonable to try one of them and see what they were talking about. Apparently they are in very great demand for it wasn't easy to locate one. I finally rounded up an 80 meter top section and the fold-over bottom unit.



Close-up of joint.

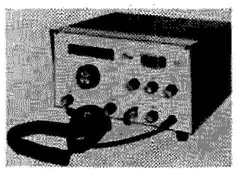
The lower mast looks and feels like it will withstand just about anything. It is made out of aircraft aluminum tubing and has a very clever fold-over arrangement. To fold it over all you have to do is lift the upper section which fits snugly over the bottom. The two are fastened together so they can't come completely apart, but just far enough to expose the joint for folding.

The coil unit is encased in black epoxy and is striking to see with its particularly identifying white stripe near the bottom. I don't think that rain, sleet, or anything short of a rather hefty steam-roller will affect the coil.

The top whip is made out of tapered stainless steel and can be adjusted according to a chart that comes with the antenna to tune over any portion of the band you choose. I set mine for the high end and the SB-33 tuned up into it with no problems.

Frankly I've worked out with this setup a lot better than I ever expected, considering the relatively low power of the rig. While putting around up here in New Hampshire I've talked with fellows all over the midwest and down to Florida. It is really great to be mobile again and to be back in contact with the hundreds of old friends on 75.

New Products

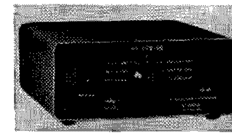


Clegg 22'er

Clegg's new 22'er 2 meter transceiver has many interesting features. The receiver uses a Nuvistor g. g. rf stage for high sensitivity and low noise figure, tunable 1st and 2nd *if*'s and bandpass circuits for excellent rejection of spurious signals. The 3rd *if* is crystal controlled at 455 kc for good VHF selectivity. Other features of the receiver are squelch, ANL, 2 watts of audio and excellent AGC. The transmitter runs 20 watts input to a 2E26. Plenty of drive is furnished with broadband exciter stages for easy QSY'ing. The final tank is tapped down to improve efficiency. A built-in tvi-itv filter is included for both transmitting and receiving. High level plate and screen modulation, a spotting switch and PTT with switching for an external VFO or linear are other features. The meter serves for signal strength on receive and relative output on transmitt. 115 vac and 12 vdc power supplies are provided. Price is $239.50. Squires-Sanders, Martinsville Road, Liberty Corner, Millington, N. J.

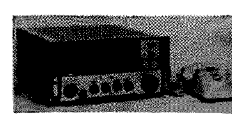
Amitron RF Toroid Kit

Amitron is known among hams chiefly for their ingenious EZ Etch printed circuit kit. It makes printed circuits as easy to make as possible. Now they've come out with another very clever kit. It's the Signal RF Toroid Kit. You've been wondering where to find toroids with known characteristics for some of your projects. Here's where. The kit contains two small toroids designed for use between 1 Mc and 60 Mc, plenty of wire and instructions and application notes. The notes make it easy to find the proper number of turns for the inductance (and frequency) you want. Among the many uses for the toroids are: tanks, pi networks, baluns, rf transformers, bandpass filters, multiband tuners, loading coils, traps, VFO's, etc. Amitron Associates, 12033 Otsego St., North Hollywood, Cal.



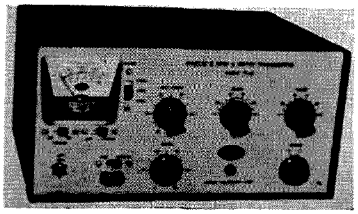
Waters Nuverter

Waters sent us one of their Nuverters to check. It's a very fine piece of gear—just what you'd expect from them. It covers 50.0-51.8 Mc and 144.0-145.8 Mc with 28.5-29.1 Mc output. The power supply is built in, but provision is made for an external supply if you want to use the Nuverter mobile. The all Nuvistor circuit produces a sensitivity of less than .1 μv and the noise figure is less than 3.5 db on 6 or 4 db on 2. The most outstanding feature of the Nuverter is its freedom from images and other spurious signals that plague many other high gain, low noise units. Waters uses very careful shielding and filtering and numerous bandpass circuits to accomplish this. There is even a connection for external AGC if you want to use it. That plus the built in gain control provide excellent protection from overloading and attendant cross-modulation. The unit is very small (2¾ × 6½ × 7½), well built and attractive. The front panel is reversible for vertical or horizontal mounting. We've tried most of the VHF converters and this is one of the best. $175. Waters, Wayland, Mass.



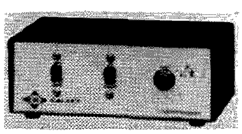
RF Communications SSB Transceiver

R F Communications has announced a new single sideband transceiver for teletype, facsimile and CW applications as well as voice transmission. The power rating of the Model SB-6FA is 125 watts PEP and average in continuous duty service at ambient temperatures up to 150°F. This transceiver provides communications on six fixed channels over the frequency range of 1.6 to 16 Mc. It is intended for commercial and government applications, and makes possible reliable communications over distances of 25 to 1000 miles. Stability is better than one part per million, which is ideal for FSK applications and makes possible extended use in phone service without the need for tuning and adjustment by an unskilled operator. R F Communications expects to find widespread interest in this new SSB transceiver among its government customers in the United States, as well as its many government, military and industrial overseas customers. List price on the SB-6FA is $1600. RF Communications, 1680 University Ave., Rochester, N. Y.



Ameco 6 and 2 Transmitter

Ameco's new TX-62 6 and 2 meter transmitter looks mighty nice. It's complete with modulator and solid state power supply in an attractive, well ventilated 11½ × 9 × 6 in. cabinet. It covers all of 6 and 2 and uses either 8 Mc crystals or an external VFO. The final tube is a 7984 Compactron designed for VHF use with 35w place dissipation. The modulator is a 6GK6. The transmitter is TVI supressed. The final grid and cathode, and output are metered. Controls: power, AM-CW, meter, band, crystal/VFO, audio gain, drive pot, and final tuning and loading. Mike/key jack is on the front panel. The price is only $149.95 wired and tested. Ameco Equipment Co., 178 Herricks Rd., Mineola, L.I., N. Y.



Galaxy Compression Amplifier

Galaxy's new Compression Amplifier will compress and amplify your voice up to 30 db to give you much more talk power. Adding the compressor will increase communications distance considerably on transmitters without ALC. It's completely transistorized, compact and complete. Power is supplied by a 9 volt battery. The compression amplifier is wired for PTT and no additional plugs are required. Size: 2⅜ x 6¾ x 3⅝. Amateur net price, $24.95. An optional AC supply is available for $6.95. Galaxy Electronics, 10 South 34th Street, Council Bluffs, Iowa.

Panco HV Supply

Need 1500 volts dc for a scope, piv tester, photoflash unit, etc.? Panco has a new high voltage power supply that is only 4¾ × 5¾ × 3½ and fits in a standard chassis. It puts out 1500 vdc, 6.3 vac and 3 adjustable voltages for a scope. It has a relay discharge to prevent it from shocking you, too. $29.80. Panco Electronics, P. O. Box 66139, Los Angeles, Cal.

Poly Paks Flyer

Poly Paks new 1965 eight page flyer lists many interesting bargains in semiconductors and other electronic components. Be sure to get your copy. Poly Paks, P. O. Box 942. South Lynnfield, Mass.

Newtronics Antennas

Newtronics has released a new bulletin NT-106 listing of their new base station and mobile antennas. It gives complete information on the Coveya 6, the 2 band mobile antennas for 6 and 2 and the Hustler hf mobile antennas. Get your copy from Newtronics, 3455 Vega Avenue, Cleveland. Ohio.

Coaxial Switches

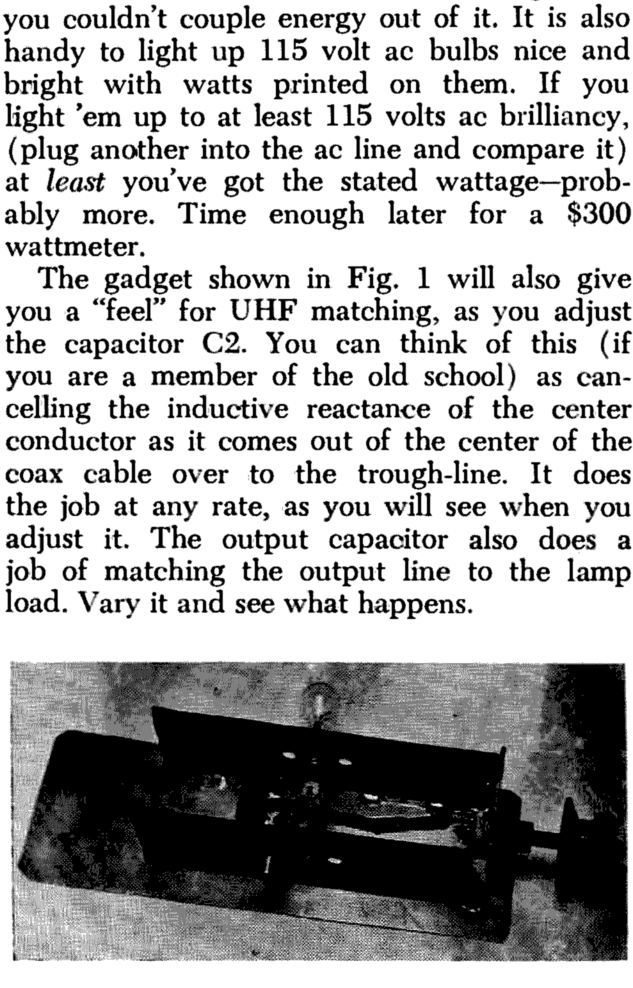
Dow Key, who most of us know through their coaxial relays, now have four different manual coax switches available. The switches are 3" in diameter and 1⅛" deep. The 1P2T and 1P3T switches sell for $12.75 and the 1P6T and transfer switch sell for $15.75. All switches come normally with UHF connectors, though N, BNC, TNC and C connectors can be had at a slightly higher price. The switches are rated at 1 kw to 500 mc and are 50 ohms. For more info write to Dow Key or see your local distributor and ask about the DK78 series switches. Dow Key, Thief River Falls, Minn.

Bill Hoisington K1CLL
Peterborough, N. H.

Low Cost UHF Power Load

An oscillator would not be much good if you couldn't couple energy out of it. It is also handy to light up 115 volt ac bulbs nice and bright with watts printed on them. If you light 'em up to at least 115 volts ac brilliancy, (plug another into the ac line and compare it) at *least* you've got the stated wattage—probably more. Time enough later for a $300 wattmeter.

The gadget shown in Fig. 1 will also give you a "feel" for UHF matching, as you adjust the capacitor C2. You can think of this (if you are a member of the old school) as cancelling the inductive reactance of the center conductor as it comes out of the center of the coax cable over to the trough-line. It does the job at any rate, as you will see when you adjust it. The output capacitor also does a job of matching the output line to the lamp load. Vary it and see what happens.



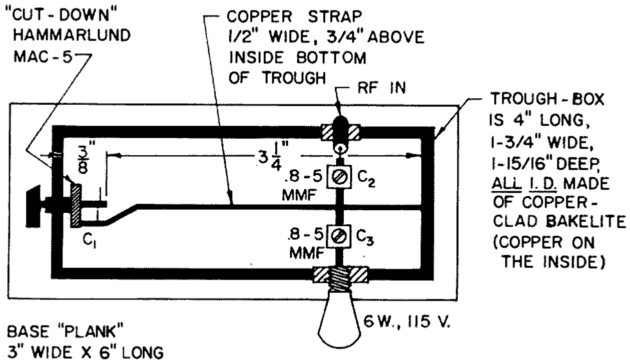


Fig. 1—Visible UHF power load, 6 watts. (At least!)

The trough line itself can be made of my old favorite material, copper-clad bakelite. If you make it exactly as shown, it will tune rom near 400 to 500 megacycles. Of course, you can shorten it a little and use a larger apacitor for greater tuning *range*.

The bulb shown is a 6 watt one, and works OK—at least up to 650 megacycles. You will nd quite a variation if you have leads on it. Not every type of bulb works at these frequencies. Reminds me of my two meter kilo- att, (1950) (the one that fell down 64 eet, along with my tower-shack, in the Kitty- emise Mountains) using a pair of surplus VT-127A's. Bought a nice shiny new 500 watt bulb and looped it into the main plate lines. Did it light up? Sure, with a big fat purple rc inside! I finally had to use five 100 watt- ers, *each* with it's own loop. I used porcelain ockets, loose on a plank under the plate line. y moving them around with a long stick, I ould get them all to light up at once, full rilliance. 500 watts! At least!

Another interesting point of experi- mentation that can be done with the oscillator nd this load concerns (A), the interlocking effects of the variation of the amount of cou- ling obtained between two tuned circuits roduced by the Q (figure of merit) of the ircuits, and (B), the Q variation brought on y varying the coupling when the loads are atched. Try unloading the lamp from the uned circuit by decreasing C3, returning C1, nd you will find the best match. L2 must be djusted while doing this of course. Another thing of interest, but don't say *I* suggested it: Try putting some steel wool (extra-fine) in the trough-line near the high voltage end. ee what happens and guess why. Or even look it up in the books, if you can find it. Have fun.

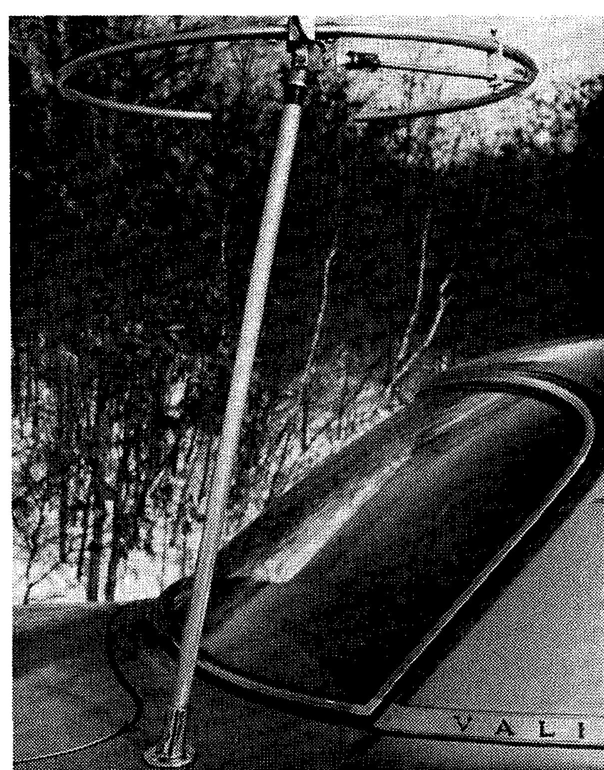
. . . K1CLL

Jack Ayres K3JZH
325 Washington Ave.
Jermyn, Pa.

Improved Halo Mount

If you've ever had a halo on your car you're aware of the snickers generated by its unsightly appearance as well as the project of removing it whenever the car is run through an automatic car wash. Determined to minimize both of these complications, I evolved the installation shown below. It not only represents a drastic improvement in the looks department but can be removed in less than a minute (with a pocket screwdriver), costs much less than the usual bumper mount and is not subject to destruction in minor rear end collisions.

The heart of the installation is a flag mount of the type used on the stern of fancy boats.



Any marine shop has them at an average of $1.75 and they conveniently accept a ¾" OD mast with a nice press fit. The only modification recommended prior to bolting it on your car is to drill and tap the "snoot" to accept one or two set screws of the type used in radio knobs. They will keep the mast from turning no matter how enthusiastic your driving may be yet are small enough to prevent accidental crushing of the mast due to overtightening.

The bottom of the fixture is open so if a hole is drilled in the car to line up with it the co-ax can be fed from inside the car through the mount, up through the mast to the top where it is brought out and connected to the antenna. The top of the mast should be sealed off around the co-ax with epoxy to prevent water from getting in and a rubber gasket placed between the base fixture and the car for the same purpose. A little Amphenol Silicon Compound smeared on the part of the mast that fits down in the fixture completes the waterproofing. The fixture serves as a template when cutting the gasket as well as in marking the car body for the three holes required to anchor it. Inner tube scrap is ideal material for the gasket.

To permit removing the mast and antenna as a unit a coupling is installed in the co-ax. There are probably a number of suitable possibilities but be sure the fitting on the antenna side of the line is small enough to fit through the base fixture. I used a pair of phono plugs joined with a double female Switchcraft fitting and although they are not intended for rf no difficulty has been encountered.

A word of caution: When selecting a location for the base make certain it will provide vertical positioning of the mast before drilling the car. Inasmuch as the fixture's "snoot" is angled a variety of locations will be possible. (By simply rotating it vertical alignment as viewed from the front and rear will be obtainable almost anywhere). If the spot you select yields a slight mast angle when viewed from the side just bend the top of the mast to restore the halo to horizontal. Inclination toward the front or rear is quite acceptable aesthetically.

This installation has been in use about three months for both the Cushcraft FM Halo shown in the photo and, alternately, a separate 2 meter halo with its own mast. Although a Saturn 6 could conceivably be burdensome to a ¾" mast, the mount should cope with any of the single-hoop 6 meter halos quite easily.

. . . K3JZH

W2NSD from p. 4

Harry Dannals was elected ARRL Director of the Hudson Division and I'm absolutely disgusted with every one of you for letting such a ghastly thing happen. He won by twelve lousy (exceedingly lousy) votes. Lotsa luck, Hudson Division. If the ARRL survives Harry you will have a chance to bail yourselves out of this terrible mess in 1966.

FCC Regulations

The new FCC view on call letters following station operators rather than the licensee of the equipment being used as disclosed in my January editorial has caused considerable comment. I knew it would.

A letter from Perry Williams W1UED, Assistant Secretary of the ARRL, is entertaining in its avoidance of the obvious. "The Commission now says that if you visit my station while I'm there, we have a choice as to whether you use my calls or yours as portable; if you visit when I'm not there (unless I'm listening in my mobile rig) you *must* sign your call as a portable." I suggest that Perry read the direct quotes of the FCC pronouncement that I published in January for what he says is *not* true. You must be in control of station if it is used with your call letters. This means that you must be able to turn it on and off yourself. Obviously this is impossible from your mobile rig.

Perry goes on to say, "The current FCC interpretation is a new and arbitrary one we think, as it flies in the face of previous FCC decisions and policies, copies of which we have on hand. Therefore we have not accepted it as actual FCC policy; it creates far too many problems for amateurs." How about that? ARRL has decided not to accept FCC policy because they don't agree with it. Perry goes on to say that the ARRL counsel is going to try to fight this out with the FCC because it will bring great problems to ARRL on such items as DXCC, where, according to the new FCC pronouncement, a DX operator could visit a nearby friend with a better station and rack up more countries than he could at home. I do hope that the FCC is able to eventually convince the ARRL who is currently making our rules for us.

RM-499

Though it is being kept under close wraps, the word from several sources is that the FCC is finally getting ready to act on this catastrophy. As I understand it, the Amateur Division has hashed over all of the material in the files and come up with a proposal which is in the hands of the Commissioners. The probability is high that they will go along with

whatever has been suggested. The contents of this proposal are rumored to be quite shocking and to affect *all* grades of licenses. There may be a change of plans again as there seems to have been last year, but all indications are for a release in early March . . . probably immediately after our April issue goes to press.

Midwest VHF Meeting

There will be a two day VHF meeting at the Holiday Inn, Sioux Falls, S. Dakota on April 10-11 complete with speakers, banquet, etc. Write Box 400, Sioux Falls, S. D. for details and tickets ($5 each).

Reciprocal Licensing

The passing of the Reciprocal Licensing Bill was the first step toward our being able to operate in other countries. Now we still have to make the agreements with the foreign countries and this has to be done through our State Department. You can do something concrete to help this little program along if you will volunteer yourself to make the effort required. Pick a country and start writing letters.

In every U. S. embassy there is a Counselor of Embassy for Economic Affairs. Under this person is the Commercial Officer and any matter under the head of "communications" falls to him. This is the man to contact. You should provide him with the following:

1. A copy of P.L. 88-313 (obtainable from the Government Printing Office).
2. A copy of the suggested language of the agreement. (The Government Printing Office will eventually have a copy of the Costa Rican agreement which will give you the formal language.)
3. The dates and numbers of all unclassified messages sent by the State Department to foreign posts regarding the matter (write the Treaty Branch of the State Department for this).
4. A written statement detailing:
   a) Explaining in detail what the agreement proposes to do.
   b) Show how the agreement will work to the advantage of the U. S. ham . . . large numbers of U. S. hams who travel compared to much fewer foreign hams who might come to the U. S. A.
   c) Cite the good will that will result from the U. S. letting down its barriers to foreign hams operating in our country, including increased travel by ham-tourists to the U. S.
   d) Explain that all U. S. government agencies have approved the language of the bill.

Have you sent in an ad for Caveat Emptor? See page 92.

Do not try to deal directly with the telecommunications section of the foreign government. Get the national radio club of that country to work on their own government. Between your efforts with our government and theirs with their government we may see reciprocal licensing become a fact instead of a promise.

If just a few fellows would take on the responsibility of seeing this through we would have quite a number of countries signed up within the next year or so . . . and we might find that this would help us considerably when we sit down with them at Geneva.

All those who don't volunteer please stay seated.

DXpedition

Brandy Ward WB6DL is looking for an amateur (or two) to accompany a group of twelve that will cover some 5000 miles of Canadian wilderness this summer, including over 2000 miles down the Mackenzie River to the Arctic Ocean in canoes. The cost of the whole trip will run about $700 which will include all meals, transportation and hotels. The trip starts at Edmonton and ends at Seattle, lasting about six weeks, including a reindeer roundup on the Arctic coast, travels with Eskimos out on the ice fields, Dawson in Yukon Territory, Fairbanks, Alaska, Mount McKinley National Park, Juneau, etc. Ham gear they've got, operators they need. Write to Ward, San Clemente High School, San Clemente, California, where he teaches. This is a trip that one will never forget, that's for sure. I'd like to make the scene myself, but how do I get away for six weeks?

African Troubles

The RSGB reported last month that it had been planned that observers from Region 1, IARU would be present at the African LF/MF Broadcasting Conference which opened in Geneva in October 1964. They had planned to discuss amateur radio problems on a long term basis with the government delegates present from the new and developing African countries. After checking around with responsible parties they gave up the idea. Sure enough, the conference was abandoned after only four days, the first ITU conference ever abandoned, as a result of political issues raised by the delegates.

Swampscott

The Dayton Hamvention and the Swampscott affair are the two biggest conventions in ham radio. Since the Swampscott convention is within easy driving distance of the 73 HQ

all of our staff will be there as usual. I've been trying to think up something unusual to do this time which might make it interesting for those of you that will be there.

So far we've had almost twice as many sub- ͻscriptions this January as last January. Now I'd like to have that delightful situation keep up so I'm planning to have a real special deal for those of you who subscribe at the conven- tion. I'm planning on having a big table full ͻf back issues so that every one who subscribes ıt the convention can pick up as many of the back issues that he is missing as he wants at ıo charge. Talk about something for nothing. . . . I shudder to think of the armloads of back ;ssues we'll see leaving. Why do I think up :idiculous things like this that I will kick my- ͻelf for later?

See you at Swampscott April 24-25th?

Chef Green

One of my hobbies is cooking, as anyone ‹who has seen my collection of avoirdupois can :estify. I won't bug you with my special wine ·eceipts, but you might give a try to a simple ittle concoction I modestly call Green's Ambrosia. A glass of this on the operating :able will steady the nerves when that scoun- łrel on the other side of town gets the DX ;tation you've been calling. Mix (a blender, f you have it) one small can of frozen orange uice concentate, five cans of water, 1/3 cup ɔf sugar and a generous scoop of vanilla ice :ream. Chill.

Jamming

A paper being circulated clandestinely in Europe calls for amateurs to jam the broadcasts ɔf short wave stations operating inside the ımateur 40 and 80 meter bands. It cites in ɔarticular the transmission of ARK, Pakistan ɔn 7008 kc, Peking on 7019 kc, Cairo on 7050 :c, China on 7080 kc and the USSR on 7100 :c.

All of these stations are transgressors and ıre operating in defiance of the UIT agree- nents. With the exception of China we should ɔe able to put considerable pressure on these tations through regular political channels. If J. S. amateurs would send official complaints o the FCC and European amateurs would ɔriginate official complaints through their gov- ernments it is quite likely that these transmit- rs would be moved.

I do believe that our taking of the law into ɔur own hands will lead more to our demise at Geneva than the removal of broadcasting sta- ons illegally in our bands.

. . . Wayne

CAVEAT EMPTOR?

We've had so many requests from 73 readers for a want ad section that we're starting one—against our better judgment. After all, we're dreadfully overworked now and are bound to have even more of a headache handling all those tiny ads. But you say you want it, so please follow these instructions when you submit ads:

- ★ Price—$2 per 25 words for non-commercial ads; $5 per 25 words for business ventures. No display ads or agency discount. Include your check with order.
- ★ Type copy on standard size paper. Phrase and punctuate exactly as you wish it to appear. No all-capital ads. Include your signature with order.
- ★ We can only accept ads related to ham radio. We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.
- ★ For $1 extra and an SASE, we can maintain a reply box for you.
- ★ We cannot check into each advertiser, so Caveat Emptor . . .

COLLINS 750A-2 receiver with 100 kc calibrator—excellent condition $250. 6 kc Mechanical filter for Collins 75A-4 receiver—new $25. W3WGH

HEATHKIT SHAWNEE—needs rcvr align. $95.00. Lettine 242 gud Cond. $35.00 Will trade for PMR8. Harvey Lawrence WB2GVF, Box 481, Bradford, N. Y.

BC 221 freq .meter, original book, 110 VAC power supply, $50. AN-PRC/6 Handie-talkie, operating on 51 MC, $27. AN-PRC/6 also on 51 MC, needs some tubes $20. Cletus G. Reinsel, W3WUA, Box 25, Bigler, Pa.

NAMTEAGS. Your name and call engraved on black, blue, or red 1" x 3" plastic with safety pin type or clutch type fastener. Two-line tag, $1.35, one-line tags, $1.15. Extra special deal to Clubs and groups. D-lux Engraving, PO Box 2, Bellevue, Nebraska.

GALAXY 300, PS300 AC power supply with clock, and Galaxy DC power supply for sale, $350 plus shipping. John Gibbs, KØUEH, 402 Tulip Lane, Omaha, Nebraska 68147.

WANTED CATALOGS AND PRICE LISTS on your surplus gear and aluminum tubing etc. Suitable for ham construction projects. Tim Morrill K1GBI, North Chichester, New Hampshire.

QSL'S, CB'S, SWL'S, Novice special. Free samples. Hamprin, Box 235, Troy, Michigan.

TWO METER STATION, complete. Communicator III with Nuvistor preamp, Gonset VFO, 6 element beam, AR22 rotator and cables. $200. Also new NCX3 with NCXAC supply. $335. WA2LIM. 212-461-1779.

NC-270 and **DX-40** with VF-1 VFO, almost new. $20C plus shipping or pickup. Bill WA8AXF, 307 Grove Street, Petosky, Mich.

SACRIFICE brand new, never used (in carton) Polycom PC-2B, 12v-115vac $266. Polycom PC-6, 12v-115vac $249. Gonset G76 and DC PS $259. Johnson 6N2 VFO $25. New transistor ignition in box orig $49, now $25. Collins mech filter new F455 43.1 $25. Want Alpa, Beseler Topcon Super D or Nikon F. Will trade for above camera or sell outright. Guthrie, P.O. Box 142, Richmond Hill, N.Y

ONE KW PHONE OR CW transmitter complete. Includes: VFO, pp final, modulator, speech amplifier, and al power supplies. $275. RME 4300 in mint condition witl speaker. $100. Prefer pick up. W. Shook, Route #1 Lafayette, Ohio.

BOMBS: Single and pair of 4-1000A finals using vacuun capacitor. Bill Brown, WØSYK, 28 Marine Lane, Hazelwood, Mo.

HEATH SENECA. AM, CW, NBFM, PM. $170. Eic 730 modulator for above. $40. Both for $190. Joseph Ciard WB2HOW, 106 Maple Street, Weehawken, N. J.

COLLINS KWM 2. $750. 516-F2, $75. Like new. Usec 20 hours. Original cartons. 31-B4 new in original carton $125. Will ship. WA2AVW. Phone 212-BU 7-0970.

NC-300 with converters, speaker 199.50. BC-779, 75.00 BC-221, 75.00. Many more items. Send for list. W2EET 2 Ridgeway, Oaklyn, N. J.

TO TRADE—Pair of 4-1000's pulled from militar class—C final for linear. Will consider clean home brev linear. Please send specifications to Les Smith, 440 Nortl Main, Empire, Oregon.

GLOBE LINEAR LA-1, 80-6M, $55. Sams Photofac 101-556 $.75 each. WAØCKH, 1339 8th St., S.W., Huron S. Dak.

DYNA-PAK—completely transistorized unit; used as signa generator. voltage monitor, continuity tester, code oscillator, code monitor and other uses. $2.98 Deltronic Labs Box 128, Horsham, Pa.

PRINTED CIRCUIT KIT—complete; two copper cla boards 2⅜ X 5, etch tray, etchant, etching resist, layou grids, cleaning pad, instructions. $2.98 Deltronic Labs Box 128, Horsham, Pa.

TUBES—Tested pullouts, guaranteed good. 4CX250B—$14 ea or $26.50 pr—4CX250R—$16 ea or $30 pr—4CX1000A—$85 ea All prices postpaid. Calif. residen add 4% tax. C & C Company, Box E, Gardena, Cali

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COLLECTORS! SW-3 with power supply, 40 and 8 meter coils, in good condition—$35.00. W5LVQ, 608 E Warner, Guthrie, Oklahoma

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Clegg 99er in excellent condition, $99. Box 154, 73 Magazine, Peterborough, N. H.

PRINTED CIRCUIT BOARDS. For many different projects. Hams, Experimenters. Send for catalog 10c. Dealer inquiries invited. P/M ELECTRONICS, Box 6288, Seattle, Washington 98188.

FOR SALE: Ranger 1, $140, Hallicrafters S-40B, $50, Globe Scout 65B, $40, National NCX-3 and NCX-A, $350. All in excellent condition. K1APA, 3 Sunny Acres, Brattleboro, Vermont.

DUMMY LOAD, 50 ohms. All bands up to legal limit. Size, 3 x 4 x 7. Coax connector. Kit $7.75, wired $9.75 pp. Ham Kits. Bx 175, Cranford, N. J.

WANTED: All types, military, commercial, airborne, ground, electronics items-testsets, GRC, PRC, Collins, Bendix, others—We pay freight. RITCO. P.O. Box 156, Annandale, Va.

SPECIAL in new and used amateur gear. We have it at an exceptional savings. Write or call Bob Grimes, 89 Aspen Road, Swampscott, Massachusetts, 617-598-2530.

CLEGG 22'er never used $195.00. Also new 44 element Cush Craft quad for 2 m. $65.00. Send check to Jerry Hirsch, 215 California Dr., Williamsville, N. Y.

NATIONAL NCX-3 and NCX-D power supply, both units in very clean condition, and operate perfectly. Late serial numbers. Priced for fast sale. $300.00. WA2OHN.

UNIT 6, 10 kc step generator of SRT14 synthesizer, new, less tubes, w/schematic, $8.00 Postpaid Check w/order. RITCO P.O. Box 156, Annandale, Va.

LICENSE PLATES wanted, old amateur radio types, for collection. Postage refunded. Tnx, Mike, WA4QED, Box 14, Milan, Tennessee.

COMPLETE SHACK—National NC-98 rcvr, Vmtr Viking II, Heath Kit VF-1, VFO, Pre-Selector RME, DB-23, Speech Clipper RME, Q-Multi, like new, in operation $325.00 W2JGQ Isaacs 231 East 11th St. N. Y. 3.

COLLINS Mechanical filters—455kcif, sixteen kcbw $12.00, eight kcbw $14.00—Pair eight and sixteen $23.00—Postpaid send check, Steve Ritter, 1422 Valleycrest Blvd., Annandale, Va.

JOYSTICK ANTENNA—All bands eighty thru ten to one KW. No traps or coils. Complete with tuner $24.90. Garland Electronics Associates, P. O. Box 1222, Garland, Texas.

HEATH APACHE—HE45B (see Feb. 73) with HE61A VFO—Saturn 6 halo and bumper mount—Gonset G33 all-band receiver. All Excellent with manuals. Best reasonable offers, no trades. K1TAX, Turtleback Road, Wilton, Conn.

RME 126, 152; Seneca; 2 & 6 Beams, 22' Booms; B & W 5100/51SB Best offers. Cliff Junkins W1UWX, 36 Carlton St., Holyoke, Mass.

SRT-14 Synthesizer units 8, 9, 10, 11A, 11B—new, less tubes—no schematic—$8.00 each or three for $20.00. . . RITCO P.O. Box 156, Annandale, Va.

WANTED: AN/TCC-3 units AM/682 and TA-219. AN/GRC sets and parts; AN/GRC-3-3, 4, 5, 6, 7, 8, 9, 10, 19, 26, 27, and any others. All PRC, PRR, VRC, VRQ, etc. All ARC sets, including AN/ARC-27, 33, 34, 38, 44, 52, 55, 57, 58, 66, and 73. AN/ARA, ARN, Collins, Bendix Aircraft Sets, R-220, R-388, R-390, R-391, SP-600. Military Test Sets AN/UPM, URM, USM, SG, ARM, etc. Metascope night viewing type equipment. AN/APR-9, 13, 14, 17, etc. Military equipment catalogs showing pictures and description of radio, radar sets, etc. We pay top prices. Technical Systems Corp., 42W. 15th St., NYC 10011. Call Ed Charol Collect.

Propagation Chart

March 1965

EASTERN UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	3	3	3	7	7	7*	14	14	14
ARGENTINA	14	7#	7#	7	7	7	14	14	14*	21	21*	14
AUSTRALIA	14	7#	7#	7#	7#	7#	7	14	14	14	14	14
CANAL ZONE	14	7	7	7	7	7	7	14	21	21	21	14
ENGLAND	7	7	3	3	3	3*	14	14	14	14	14	7#
HAWAII	14	7#	7	7	7	7	7	7#	14	14	14*	14*
INDIA	7	7	3#	3#	3#	3#	14	14	14	7#	7#	7
JAPAN	14	7#	7#	7#	3*	3*	7	7	7#	7#	7#	14
MEXICO	14	7	7	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	7#	7#	7#	3#	3#	7	7	7	7#	7#	7*
PUERTO RICO	7	7	7	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	7	7	7	7#	7#	7#	14	14	21	14*	14*	14
U. S. S. R.	7	3	3	3	3#	3#	14	14	14	7#	7#	7
WEST COAST	14	7	7	7	7	7	7	14	14	14	21	14*

Good: 2-4, 6, 7, 22-26, 28, 29
Fair: 1, 5, 8, 11, 12, 14-18, 20, 21, 27, 30, 31
Poor: 9, 10, 13, 19
VHF DX: 9, 10, 22, 23

CENTRAL UNITED STATES TO:

ALASKA	14	7	7	3	3	3	7	7	7*	14	14	14
ARGENTINA	14	7#	7#	7	7	7	14	14	14	21	21*	21
AUSTRALIA	14	14	7#	7#	7#	7#	7	7	14	14	14	14
CANAL ZONE	14	7	7	7	7	7	7	14	21	21	21	21
ENGLAND	7	7	7	3	3	3*	7	14	14	14	7#	7#
HAWAII	14	14	7#	7	7	7	7	7	14	14	14*	14*
INDIA	7	7	7#	7#	3#	3#	7#	14	7*	7#	7#	7
JAPAN	14	7#	7#	7#	3*	3*	7	7	7	7#	7#	14
MEXICO	14	7	7	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	7*	7#	7#	3#	3#	7	7	7	7#	7#	14
PUERTO RICO	14	7	7	7	7	7	14	14	14	14*	14	14
SOUTH AFRICA	7	7	7	7#	7#	7#	14	14	14*	14*	14*	14
U. S. S. R.	7	3	3	3	3#	3#	7#	14	14	7#	7#	7

J. H. Nelson

WESTERN UNITED STATES TO:

ALASKA	14	14	7	7	3	3	3	3	7	14	14	14
ARGENTINA	14	14	7#	7	7	7	7#	14	14	21	21*	21*
AUSTRALIA	21*	21*	14	7#	7#	7	7	7	14	14	14	14
CANAL ZONE	14	14	7	7	7	7	7	14	14	21	21*	21
ENGLAND	7	7	3	3	3	3#	7#	7#	14	14	7#	7#
HAWAII	21	14	14	7	7	7	7	7	14	14	21	21
INDIA	7#	14	7#	3#	3#	3#	7#	7*	7*	7	7#	7#
JAPAN	14	14	14	7#	7	7	7	7	7	7#	7#	14
MEXICO	14	7	7	7	7	7	7	7	14	14	14	14
PHILIPPINES	14*	14	14	7#	7#	7#	7	7	7	7#	7#	14
PUERTO RICO	14	7	7	7	7	7	7	14	14	21	21	14
SOUTH AFRICA	14	7	7	7#	7#	7#	7#	14	14	14*	14*	14
U. S. S. R.	7#	3#	3	3	3#	3#	7	7*	7*	7#	7#	7#
EAST COAST	14	7	7	7	7	7	7	14	14	14	21	14*

Very difficult circuit this hour.
* Next higher frequency may be useful this hour.

73

Amateur Radio

APRIL 1965
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Special SSB Transceiver Issue

'73

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ditor & Publisher

aul Franson WA4HWH/1
ssistant Editor

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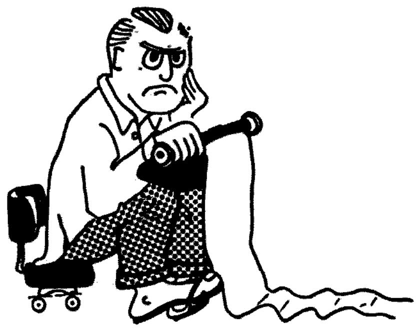


de W2NSD/1

never say die

OK fellows, I've got you right where I want you. While I've been pot shotting away at the ARRL from up here in the wilds of New Hampshire from my lofty perch on 73 Mountain, my cohorts have been busy making arrangements for me to step in and take over the League and run amateur radio as my own personal empire.

My man on the ARRL Executive Committee has thrown dust in the other eyes . . . a simple matter, really . . . and that detested Article 12 of the ARRL Articles of Association has been thrown out the window. I thought we might have a battle getting it dumped, but there was nothing to it. I sat up here telling them how awful it would be to have Dannals on the Board of Directors and they went ahead and moved heaven and earth and got him on.

Article 12? Oh, that was that old hangover from the early days of ham radio when everyone worried that someone would use the League for commercial purposes.

Article 12 states: "No person shall be eligible for the office of Director, Vice-Director or President who is commercially engaged in the manufacture, sale or rental of radio apparatus capable of being used in radio communication or commercially engaged in the publication of radio literature intended in whole or in part for consumption by radio amateurs."

So I had to wait until they threw that one out before I could announce for Director, and scheme my way, with some inside help, onto the Executive Committee. He, he.

Article 12 stood in the way of Dannals being accepted, so Article 12 got the axe instead of Dannals. Now, as seems absolutely certain, if the Board of Directors seats Dannals as the Hudson Division Director at the May Board meeting, the rule will have been completely bypassed. Dannals, you see, works for Sperry Gyroscope at Lake Success, New York. According to the Electronic Engineer's Master, Sperry makes the following radio apparatus capable of being used in radio communication: Aircraft communications systems, airport traffic control systems, microwave communications systems, telemetering systems, microwave transmitters, radar transmitters, telemetry transmitters, VLF, UHF and VHF transmitters, beacon, command, direction finding, interrogation loran, microwave and UHF/VHF receivers. Obviously Dannals is intimately engaged in the specific activity that is prohibited by Article 12. OK, so the Directors have a choice of throwing out either Dannals or Article 12. How about that Vice-Director, Stan Zak K2SJO? Well, Stan works for Madam Bell, that ubiquitous gal who is even more involved in manufacturing, sale and rental of radio communications equipment than Sperry. With over 7% of the Hudson Division members of the League dropping out last year, perhaps they don't need any representation anyway.

K6BX Really Does It

For some months now I have been devoting quite a few spare moments to a compilation of facts which are under the working title of the "ARRL Black Paper." This accumulation of data, letters, bulletins, statements, etc., all document in considerable detail events which the League headquarters is trying desperately to keep secret. Few amateurs realize the extent that the ARRL is ruled by commercial interests, for instance.

So along comes a twenty-two page exposé of ARRL management from Clif Evans K6BX that makes my effort look puny. Clif, in his usually pungent style, quotes at length from confidential letters written by directors to other directors and assistant directors, exposing plots and events that would be considered completely unbelievable if they were not thoroughly documented. This is an incredible tale of corruption and callous disregard for the ARRL membership that will shake the League to its core.

Frankly, I would like to print some of the material here so you could see the fantastic extent that things have gone, but Clif has the

Continued on p. 86.

Robert N. Tellefsen, W7SMC/6
277B Tyrella
Mountain View, California 94041

Europe on Two?

Oscar III will make a number of firsts posble. Will a trans-Atlantic QSO in the 2-meter and be one of them? There is a chance that is will be possible with the help of this amaur Telstar.

When Oscar's I and II were in orbit, their ltitudes were about 250 and 270 miles, repectively, and they were heard by tracking tations at distances of more than 1000 miles. f they had been repeating satellites, contacts ould have been possible between stations ore than 2000 miles apart; how much more difficult to estimate. Analysis of observation eports on Oscar's I and II shows that Oscar I as heard by stations on the east and west oasts at the same instant, giving a range of bout 2200 miles.

How does this make trans-Atlantic 2-meter ontacts possible? The range prediction for scar III, more than 2000 miles, is based on he Oscar's I and II observation reports, and n the assumption that the altitude of the scar III orbit will be similar to the altitudes f the Oscar's I and II orbits. These represent ear minimum altitudes, since a satellite placed n a lower orbit would not remain there long. scar II, with an apogee of 249 miles, rentered the earth's atmosphere before comleting 300 orbits.

Obviously more altitude will be necessary o enable contacts between the U. S. and Europe, but not much more, since the distance rom New England to Great Britain is beween 2500 and 3000 miles. A 300-mile high rbit would do it. If the Oscar III orbit is igher than those of its predecessors, or if the Oscar III orbit is similar in altitude to the Oscar's I and II orbits but more elliptical, trans-Atlantic contacts should be possible.

The contacts would be at extreme range nd so would be short, probably similar to meteor scatter contacts, lasting perhaps a minute or so at a guess. Prearranged schedules would be a necessity for contacts, but anyone monitoring the satellite output frequencies might be able to hear a European or two, most likely in England, Scotland, or Ireland.

A kilowatt would be helpful, as would a good antenna mounted high with a good view of the Atlantic horizon. The antenna need only rotate in azimuth, as the satellite will be travelling along the horizon.

The Oscar III frequencies are as follows: input pass band 144.075 to 144.125 mc, output pass band 145.875 to 145.925 mc, telemetry transmitter output 145.85 mc, and the coherent beacon output 145.95 mc. Frequency inversion takes place within the satellite, so a signal at the low end of the input pass band will come out at the high end of the output pass band. A signal entering the satellite at 144.080 mc would come out at 145.920 mc, and so on. Also, due to the frequency inversion, signals passing through the satellite will have their sidebands reversed. Upper-sideband SSB will come out as lower sideband, and RTTY signals would have their mark and space frequencies reversed when using frequency-shift keying.

To determine when Oscar III will be in common view of an English and a U. S. station, see the article on an orbit predictor in the March issue of 73. As a line between the two stations becomes more perpendicular to the path of the satellite track across the surface of the earth, the possible length of contact will increase.

No-one can promise that trans-Atlantic contacts will take place, but the possibility is there. Will you be the first to work Europe on 2 meters?

. . . W7SMC/6

Letter from Gus

Feb. 5, 1965
Dechencholing, Bhutan

I suppose many of the DX gang has been wondering about why I did not show up in AC land before now. Well that's a story all by itself. You ask anyone who ever tried to get that all important "Innerline Permit." About all I can say is this was the toughest one that I have ever tackled. Peggy and I were at the point of leaving Calcutta any number of times because it was really touch and go all the way, even though things I thought had been pretty well fixed a long time before we left the U.S.A. In fact I thought they were all OK even before I departed from here early last Spring. Well many things have been happening in this section of the world, and many of these things have a strong tendency to not encourage permits to be issued to visitors, even though I had been here before and had made good friends with many of the high officials. It's a very long story, much too long to tell in a few words. Eventually I hope to get around to the whole works.

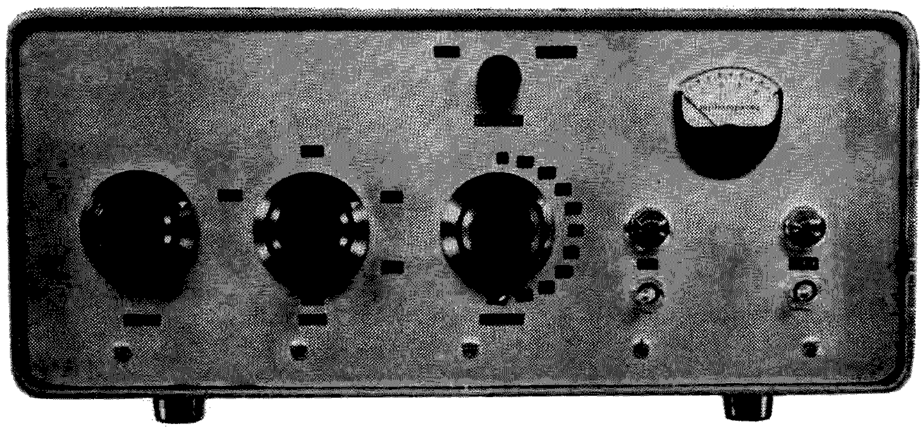
Well we arrived at Phuntscholing, Bhutan on the 21st. of Jan. with no equipment. My equipment was due to arrive from N. Y. on about the 27th. To this day it is still not here. We departed from Phuntscholing, Bhutan for here on Feb. 1st. We arrived here on the 2nd. Boy, may wife Peggy almost had a fit on that mountain road. If you can picture a narrow unpaved mountain road that's only 127 miles, that takes 2 days to cover you may have some idea of what she went through even though she had taken 2 tranquilizers, aspirins, and a few other nerve controlling medicines. When you leave Phuntscholing you go about one city block and "Slam Bang" you are in the mountains. The road starts by going uphill, with hair pin curves about every 100 feet, and it just keeps on going up and up and up, with the sheer drop offs getting deeper all the time. Every time I have made this trip it seems to give me another thrill and I have now made it 7 times. I am on the air with AC5PN's transceiver which will tune just 2 kc from my operating frequency. I am expecting my good equipment anytime now.

Tell the fellows to call me very close to my frequency, call down the band but not over 3 kc at the most. I will indicate when to call me further than this. Will be on 7 mc and 3.5 mc in a few days with a good antenna. Boy the band sure is stinko. But it's still W3CRA S8 when the other fellows are at the best S4 or 5. It has been Long Path from 1145 to 1330 GMT. No W6's or 7's yet at all. I am really going to work on my antenna and try to get a better signal. I am surrounded by mountains, being in the middle of the Thimphu Valley. Long path looks good so far. Trying 0100 to 0300 GMT—also but no soap yet. Two VE8's only.

. . . Gus

Gus' Travels and Tribulations

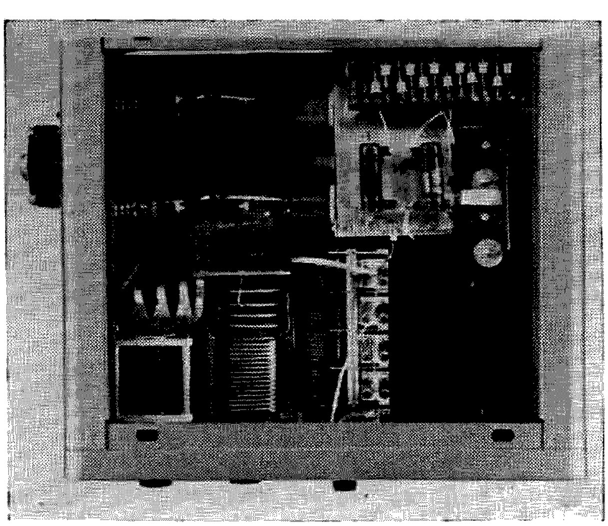
This is the first installment on Gus' current activities. We hope, mail service permitting, to have a letter every month from Gus telling what he is hearing and what is going on in the DX world. In addition to this letter we will start next month with a regular series of articles on Gus' adventures. 73, the new DX magazine.



1 KW PEP

Whit Daily W9EWL/Ø
4411 Forest Park Blvd
St. Louis 8, Missouri

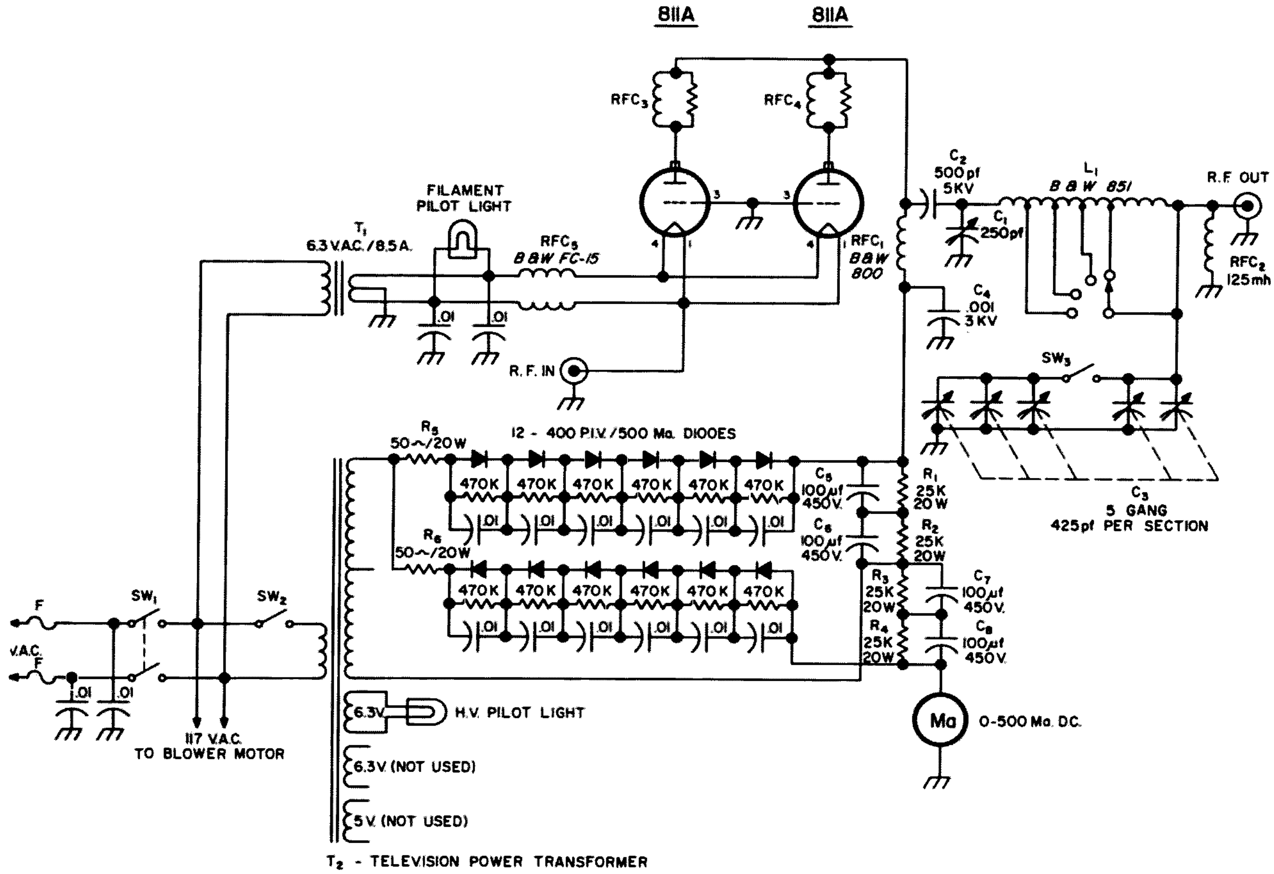
In an amazingly short number of years, the emphasis on amateur radio gear has changed from "the bigger the better" to "let's have it neat and compact as possible." This amplifier was designed primarily to be used with one of the many fine tranceivers on the market today. For this use, we felt that certain requirements were definitely in order: 1. The amplifier should be small and neat in appearance so as not to disrupt the order of the household. 2. It should be easily driven by and compatible with the transceiver. 3. It should run enough power to make it worthwhile. 4. It should be bandswitching. 5. It should be inexpensive and practical to build. 6. Last but not least, it should be challenging but not impossible to build. This amplifier is the size of the SR-150; is driven to full output with about 30 watts; runs 500 watts DC input (that's 1000 watts PEP); is fully bandswitching; uses common parts; has a total cost under 100 dollars; and is certainly not beyond the scope of the average builder with a little ingenuity.



Top view of Small Fry.

The adequate driving power of most transceivers suggests grounded grid operation. The 811A is a proven favorite and it has established a reputation as a lot of tube for the money. The B&W tapped coil was chosen because it is compact, relatively inexpensive, provides an acceptable Q on all bands, and is a very easy way around the problem of bandswitching. One could use a roller inductor coil, but this necessitates the need for a counter dial. However, the nice thing about using the roller inductor is that L-C ratios can be juggled to have optimum operating efficiency on each band.

The loading condenser is a five gang, 425 pf per section variable condenser that was obtained at the local surplus house. This condenser has been advertised by many of the surplus houses across the nation and should not be difficult to obtain. Three gang broadcast variables are readily available from any supply house and could be used, but some loading flexibility would be sacrificed. The five gang variable is set up in such a way as to provide using two sections alone or a total of five sections after switching in the other three sections when more output capacitance is required. This gives a tunable capacitance range of 850 or 2125 pfd and eliminates the need for messy switchable capacitors. A B&W FC-15 filament choke is used to isolate the filament transformer so that the driving power is applied directly to the filaments (cathode)



Small Fry.

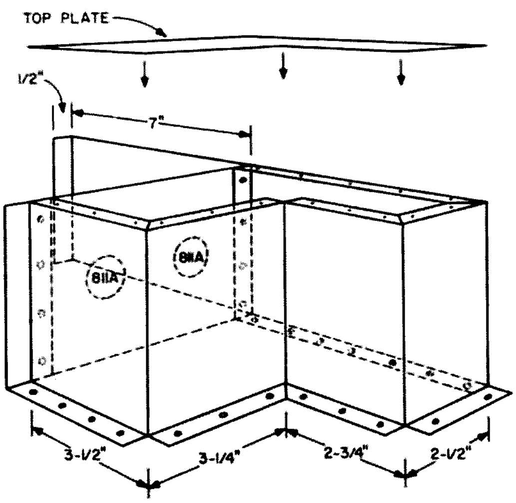
hrough a .01 mf disc ceramic. The metering s in the negative side of the plate supply and ;erves as a check on the operating conditions)f the amplifier.

It seems that the rage today is to pull a KW)ut of an old TV power transformer and a 1andful of petite, inexpensive silicon diodes. A KW is questionable; but at 500 watts DC input, the transformer that was used barely gets warm. This transformer is from an old Philco twin-chassis TV set and is rated at something like 540 volts at 360 ma and has three filament windings of considerable amperage, which were not used in order to lessen core saturation when high amperage is drawn from the transformer. Most any old TV power transformer could probably be used, and old TV sets are available for almost a dime a dozen. One word of caution: Color coding of the transformer leads are different on the transformers in different sets, so take note when removing the transformer or check out the windings with an ohmmeter before automatically wiring it up using standard color codes.

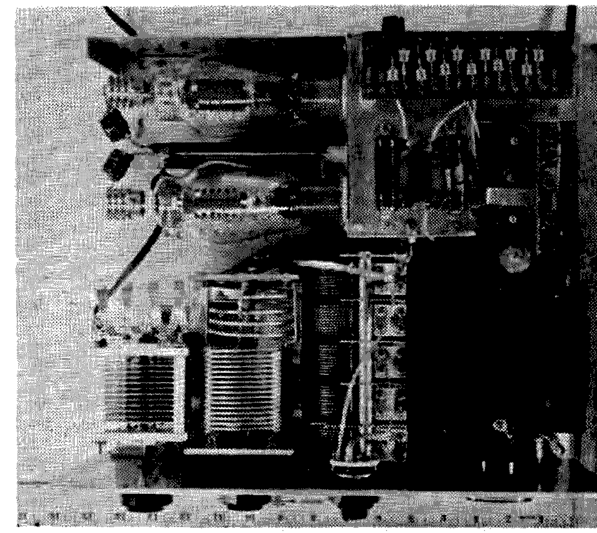
The diodes used in this instance (because they happened to be on sale) were 400 PIV at 500 ma. Six diodes were used in each leg of the voltage doubler. The diodes were rated by the manufacturer at 140 volts rms. 6×140 equals 840 volts which gives more than enough safety factor for the diodes. 470k-½ watt resistors and .01 μf 1000 wv disc ceramics are connected across each diode in order to compensate for variations in the characteristics of the different diodes. The 50 ohm-20 watt resistor in series with each leg provides protection for the diodes from abnormal surge currents such as those encountered when first turning on the high voltage with the filter capacitors in an uncharged state. Four 100 μf 450 wv electrolytics are used, and this gives a quite respectable value of 25 μf on the output of the power supply. 25k-20 watt resistors across each electrolytic work as both equalizing resistors and as a bleeder. No, we didn't forget the filter choke. It is certainly not needed, particularly with a voltage doubler. The voltage delivered is 540×2.82 (peak AC voltage factor for a voltage doubler) which is 1523 volts theoretically. Actually, there is about 1550 volts delivered from this particular transformer; and this drops to about 1400 volts under a 350 ma load. A fused plug is incorporated with 8 amp fuses in each leg of the AC line.

Construction

It must be confessed that the cabinet was the starting point for construction. It is always more fun (and also more work) to start with a



Construction of shield box.


Top view of a cabinet.

certain size box and then try to cram everything into it. The cabinet used in this instance was the same as that used to house the Hallicrafters SR-150. It should be no problem to have a good sheet metal man construct a cabinet from light weight steel or to build a cabinet using Reynolds' ¾" angle stock and do-it-yourself perforated aluminum. Styling is up to you.

The front panel and the chassis plate were cut from 3/16" aluminum plate stock. Standard ⅛" aluminum panel available in any supply house should be fine though. The front panel and the bottom plate are mated with a piece of ¾" aluminum angle. It was surprising, but more than adequate strength was present in this instance without the use of side braces.

The initial problem of shielding the grid and filament circuit was solved by the sheet metal man down the street (at a cost of $2.50). The L shaped box was constructed of light sheet aluminum as shown in the drawing. This box is mounted to the bottom plate with ¼"-6/32 screws tapped into the bottom plate.

At this point, may it be noted that instead of using nuts on the mounting screws, the holes in the bottom plate were tapped with a 6-32 or 8-32 tap so that protruding nuts on the bottom would not prevent the assembly from easily sliding into the cabinet.

This L shaped box provides just enough room for the filament choke, the filament transformer and the tube sockets. The leads from the filament transformer (AC primary, pilot light, and center-tap) are passed through rubber grommets on the side facing the power transformer. The coax connector for the input to the amplifier is mounted on the back side of the box. The grids of the 811A's are directly grounded by bending the pin down and soldering to the frame of the tube socket. The box is flanged as noted, and an aluminum plate is fastened to this flange by small ¼" metal screws to complete the top.

The power transformer is mounted directly in front of this L-box using two lengths of 8-32 threaded stock through the core to the bottom plate. By using the L shaped custom aluminum box, we have a cutout just large enough to hold the four electrolytic condensers and their equalizing resistors that have previously been mounted on a 3½" × 5½" × 1/16" phenolic board. The resistors are mounted on the phenolic board facing the outside in order that they might have adequate ventilation. This condenser-resistor assembly is mounted by using a small piece of aluminum angle to the bottom plate and is braced at the top by a small ⅜" aluminum strap connected to the L-box. There is just enough room between the power transformer and the front panel to provide space for the filament and plate switches, the pilot lights, and the plate meter.

The top plate on the L shaped aluminum box is used for the mounting of the surge resistors and the bank of silicon diodes. A piece of 1/16" phenolic board is again used with the diodes mounted on the top side and the 470K ohm equalizing resistors and the .01mfd capacitors mounted on the underside. This assembly is mounted on four one inch porcelain standoff insulators. The 811A's are mounted horizontally as shown in the photograph with the plate choke mounted horizontally and somewhat below the tubes. The blocking capacitor is mounted on a porcelain insulator that is fastened to the bottom plate. The tuning condenser, plate coil, and loading condenser are mounted side by side as shown in the photograph. The two condensers are mounted

ı aluminum spacers in order that the shafts ill all be at the same level. There is just ıough room directly above the loading con-ənser to mount the ceramic switch for switch-ıg the ganged sections of the loading con-ənser. Copper strap (actually the outside ıield of RG-59U coax pressed flat) is used to ›nnect the plate tuning components together. short piece of RG8U coax is used to connect ıe coax connector on the back aluminum late to the B&W coil. This runs close to the ›ttom plate and under the tubes and RF ıoke.

A small phonograph motor with a three ıch fan blade is mounted on the cabinet and lows directly on the tops of the 811A's to pro-ide ventilation and cooling. A series of ¼" oles are drilled into the bottom plate directly nder the tubes to provide for additional air ›w. Heat dissipating type connectors are al-› used to help keep the tubes cool.

Check for parasitic oscillations on twenty nd fifteen meters. We finally wound up with ve turns of #16 enamel wire around two 100 hm 2 watt resistors in parallel for parasitic ıokes in the 811A plate leads. One may have › experiment with the number of turns on ıe resistors but the least number that one ın get by with is best. This amplifier is cer-ıinly wild without the chokes in the plate ›ads though.

The static plate current for the 811A's un-er these conditions is approximately 60 ma. 'he amplifier should be loaded as heavily as ossible into the antenna and then talked up › 300 to 350 ma plate current wise which is ıe optimum full load operating condition. late meter readings are sometimes confusing ut are not much good for tuning purposes. It : suggested than an SWR bridge or output ıeter be used for tuning and everything tuned ›r maximum output.

In using the amplifier with a transceiver, a ·ansfer switch is needed. We used an old)PDT relay with ceramic insulation and about 0 amp contacts. This is mounted in a small ›ud mini-box and the coaxial leads brought ut directly to coax connectors that connect to he transceiver, the amplifier, and the antenna r SWR bridge. We have encountered no ıfficulty with this lashup and it works fine. Ve would have liked to mount the relay in the ınal but there just was not room. The ampli-ıer has been in use for a couple of months, ; very adequately driven by the SB-33 and has ;iven a good account for itself on all bands. We ıave even given up on perhaps seeing the ittle silicon diodes go up in a whiff of smoke!

. . . W9EWL/Ø

Bill Hoisington K1CLI
Peterborough, N. H.

6 Meter Heterodyne VFO Transmitter

Compactron tubes have many advantages for ham use. They were developed for commercial applications where their main advantage is economy: They are squat tubes with 12 pins, set in an all-glass envelope. Because of the large number of pins, most Compactrons contain more than one unit. For instance, the 6J11 has two completely separate and shielded high gain if pentodes, each with a Gm of 14,000. That is high. Compare it with 4300 for the 6BA6! The 6D10 has 1½ 12AT7's in it. That's three good triodes of 2½ watts dissipation each. The 6M11 has two of these (12AT7) triodes and a 14k Gm type 6EW6 as well. In addition, the Compactrons have a large pin circle diameter for more insulation and higher plate voltage. Tube leads are also short and direct for good high frequency performance. You can see the many possibilities for amateur use.

I built a two tube VFO heterodyne transmitter using one Compactron. The final tube is an old 815, but could easily be one of the Compactron power tubes. The most interesting part of the circuit is the heterodyne, or conversion, VFO, where a stable 3 to 4 Mc variable oscillator is added to a 47 Mc crystal oscillator in a mixer. This avoids multiplying the VFO output, so the mixer output on 50 Mc will be very stable as the crystal oscillator can easily be made drift-free.

I started the transmitter with a 6AF11, which has a triode and a 6CX8 in it. This tube is very useful for the heterodyne circuit. As soon as I put the 12 pin socket in *one* hole, wired up *one* filament lead and soldered three cathode tabs to the tube ring, I began to appreciate the economy of labor involved with Compactrons. I checked the various sections of the 6AF11, which has two good triodes and a super-dooper video type pentode with five watt dissipation (almost a 5763). These tube people may be nervous about transistors, but they're not surrendering peacefully. Those triodes are good! The 47 Mc crysta oscillator starts off with only 8 volts plate volt age. And the pentode section puts out on watt of stable six meter energy even thougl it is acting as a mixer. All this is one smal bottle for $2.

Now to the details. I used the highest gai triode for the 47 Mc oscillator, since it need the gain. When I build an oscillator, I alway set up a good tuned plate circuit and pick u the least amount of out-of-phase energy possibl to the grid. It has always worked well for me Fig. 1 shows the circuit. Simple, isn't it? L2 i inserted in L1. The coupling may be varied for tests but it is not critical. It is impor tant to keep the plate voltage below 100 volts You can use a voltage regulator if you like, but I didn't find one necessary.

The Variable Oscillator

Here again, a good plate circuit is set up After all, it's the plate that generates the pow er. An airwound coil is used, tuned to 3 to 4 megacycles. There are some who maintain that the plate should be grounded to avoid "heat expansion trouble." They perhaps forget to mention that the plate-grid capacity is still present and would cause frequency shift if the plate did expand with heat. This one is stable, as is.

An air capacitor is used as a parallel pad to set the frequency on the dial. Here also you are interested in a certain amount of power. Don't forget, this is a transmitting circuit. C4 is a Hammarlund MAPC-100 with a screwdriver shaft. C3 is a Hammarlund MAPC-100B with ¼ inch shaft. They are air capacitors so they will not vary with temperature. C5 spreads the frequency out on the dial. The variable frequency control portion may be made a lot more fancy if you like, with slow-motion dial, switching for every half megacycle, etc. I just brought the shaft out wit an insulating extender and put a long pointer knob on it.

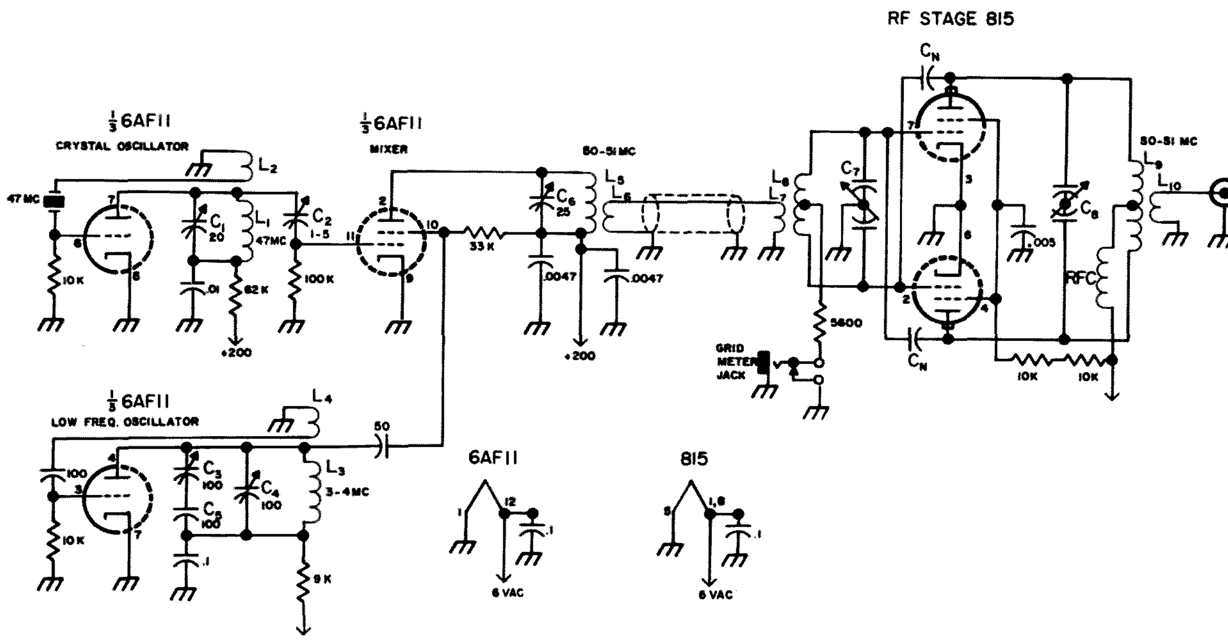


Fig. 1. 6 Meter Heterodyne Transmitter.

L1. 7 turns airwound, 16 turns per inch ⅝ in. diameter. B & W 3003, Air Dux 416T.
L2. 6 turns of plastic covered No. 22, ¼ in. O.D., ⅜ in. long. Inside L1.
L3. 2 in. of ½ in. dia. 32 turns per in. B & W 3004, Air Dux 432T.
L4. 15 turns of No. 28 dcc wound on cold end of L5.
L5. 13 turns airwound 8 tpi.
L6. 2 turn adjustable link over cold end of L5.
L7. One turn link near center of L2.
L8. 4 turns No. 14 enamel, 1¼ in. O.D. 1 in. long.
L9. 6 turns No. 14, ¾ in. O.D., 1½ in. long.
L10. 2 turns near center of L3.
C1. Hammarlund MAC-20.
C2. 1-5 pf mica trimmer.
C3. Hammarlund MAPC-100B. "Tune."
C4. Hammarlund MAPC-100. "Set."
C5. 100 pf silver mica.
C6. Hammarlund MAPC-25B.
C7. Hammarlund BFC-12.
C8. Hammarlund BFC-12.

The crystal oscillator is fed into the grid of 1e pentode mixer through C2, a 1 to 5 pf 1ica compression capacitor. For adjustment of :2 first open it up and get the crystal oscil-1tor running properly, with a gradual increase 1 grid current (open the ground end of the rid resistor and put in a milliammeter) on ne side of resonance, and an abrupt drop on 1e other. The presence of the regenerative oil (L2) makes the operation much less criti-al, as you can check. As you increase the 3edback of L2 you will see a greater region f power out and less abrupt drop. CI hould tune to resonance near the middle of :s range. With the oscillator running proper-y, increase C2, putting more power into the 1ixer grid. Too much C2 will knock out the rystal oscillator and cause self-oscillation of he pentode. It is very stable over the useful ange though.

The variable oscillator is coupled into the 1ixer screen with a 50 pf capacitor. This sec-ion worked perfectly right away and has not lrifted since. It is very uncritical and very table.

The mixer plate is simply another good 50 Mc coil, tuned with a Hammarlund MAPC-25B air capacitor. With both oscillators running, 47 Mc and 3 Mc, peaks of energy will be found at 44, 47, and 50 megacycles, the sum and the difference of the two oscillators, and their fundamentals. The 3 Mc fundamental naturally does not show up in a 50 Mc plate circuit. I obtained about one watt out of the plate on 50 Mc. Do *not* ever use this on the air without at least two more tuned circuits, as the 47 Mc energy is only some 10 db down. Link coupling over to the final grid circuit of an rf amplifier, such as an 815, plus a good plate circuit on the 815, will result in the 47 and 44 Mc energy being way way down.

The RF Stage

Almost any good tube that will put out 25 watts or more and operate on 1 watt input on 50 Mc will do. I used my old favorite, the 815. It neutralizes easily and can be bought for as low as $1.75 surplus. Fig. 1 shows the circuit. It is quite standard; tunes up easily;

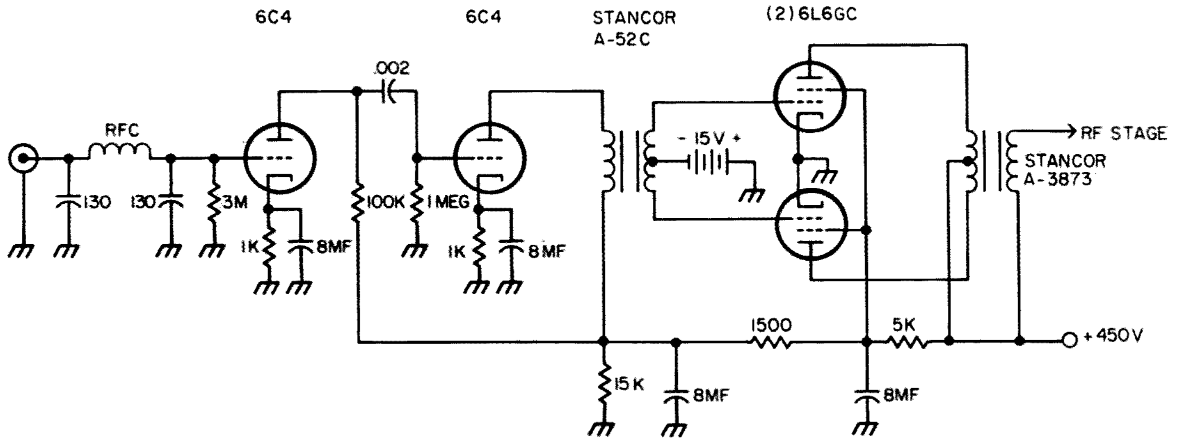


Fig. 2. Modulator.

and the neutralizing holds "once and for all." It is essentially the same as the "Six Meter Linear" described in 73, with a change in the grid bias and modulator connections.

The Modulator

Fig. 2 shows the modulator circuit. It works, and works good enough so that the modulation reports were "better than average," "clear as a bell," and "no trash or hash of any kind."

After getting the 6C4 driver stage running, I put another 6C4 in front and plugged in my low-cost Astatic mike. Immediately, rf feedback. This time I was able to cure it with an rf choke and two 130 pf capacitors between the mike jack and the grid. No feedback at any time since. The two 6C4's just about do the job, but only just. I'm going to put in a 6AT6, which has a much greater amplification factor.

On The Air Tests

This was interesting. I started about 3 pm on a weekday and everything was fine while talking to the student types (it was summer) and retired lads. "No drift," "FB," etc. About 5 p.m some working type operators began to show up on the band, with more money and thus more selective receivers. Some of these had *sharp* receivers and reported a slight but steady drift. So, off the air again and back to the bench. I checked the variable 3 Mc section. No drift.

I checked the crystal. Drift! Why the crystal oscillator? Well, as I have said many times, these VHF crystals will *not* stand over 100 volts on the plate of the triode. I put my voltmeter on the B-plus and sure enough,150 volts. My own fault. Increasing the dropping resistor and lowering the volts on the plate to 100 took out the drift nicely and no more drift has been reported since.

For frequency spotting, the 6AF11 power supply is switched on without the final. It puts a large signal into the receiver, but witl a beam antenna on the receiver you can hea the desired carrier through it.

The next job was to get the entire "station assembled on three shelves with a handle fo portability. The top shelf has the conversio VFO, final and the transmit-receive switcl The middle shelf holds the modulator, an down below are the two power supplies. I too it up to 73 Mountain near Peterborough, N.H for a 6 hour work-out. No drift reported at an time from a number of sharp receivers, an all modulation reports good to excellent.

Conclusion

Some interesting comments were heard. Th appearance of a new home-brew rig on th air seems to be a rarity these days. And a for a single tube double-oscillator-converte VFO; well, very few that I talked to had an idea of what it was, even after I explained it Apparently today the home-brewer type (o rigs, that is) is really scarce. The old divisio of customers into two distinct classes is be coming sharper. Class 1. Young lads, time o their hands to build, not enough money t buy ready-made gear. Class 2. The workin type, busy making money, no time to build This change over seems to be accompanied b the acquisition of an XYL and numerous junio oscillators I noticed this consistently whe building beams, (UHF Resonator Co., Rye N. Y., 1946 to 1950). Class 1 types would as for dimensions. Class 2 types would sen checks for beams. Today with the heavy pres sure on a young lad to get his education thi deal is accentuated. He doesn't have mucl money while learning, and he has less tim now as well. So maybe some new ideas o low-cost, easy-to-build, circuits, rigs, an beams going from 50 to 1296 megacycles ma help. I'm trying anyway. And it's fun too!

. . . K1CLI

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Ann Arbor, Michigan

A Kostless Keyer

All of us at one time or another have had a hankering to own a keyer. Some of us resisted the impulse because the cost outweighed the need. The circuit shown in Fig. 1 is my compromise. Although no claim is made that this keyer will replace a TO keyer, it does make self completing dots and dashes of uniform length at speeds from 9 to 35 wpm. Moreover, aside from the sensitive type relay L, most of the parts can be found in an average junk box.

The theory of operation is based on the fact that good condensers charge very fast. (See Fig. 1.) As the key is closed connecting the common and dot terminals, C_1 charges instantly (almost) to 9 volts, thus applying a charge to the base of T_1, causing current to flow through T_1 and closing the relay. But then as L closes, the 9 volts across C_1 is disconnected, allowing C_1 to discharge slowly and at a controllable rate across the speed control R_0. (See Fig. 2.)

Now for practical details. Many transistors were tried for T_1 and T_2, all with success. For instance, 2N168A and other general purpose types worked. However, if PNP's are used, the polarity of C_1, C_2, and E must be reversed. However, good condensers must be used for C_1 and C_2, (for instance the Sprague TE 1300 for C_2). As a rough guide, pick 10 to 50 wvdc types, *not* electrolytics. As for the speed control R_0 and R_0', they must work on the same shaft and can be found surplus for less than .50¢; a distinct improvement would be the use of logarithmic tapers but this is not necessary.

The relay is the only rub. Whatever relay is used, it must have a coil resistance of 6 k to 8.7 k, and a closing current of .6 ma. The upper limit of 35 wpm is due to the slowness of the suggested Advance relay. On the other hand, this slowness provides a pleasing weight to the characters, although a weight control of a 20 k pot across L would be an improvement.

Adjustments of the ratio control and a means of constructing a cheap key are described in the 63 ARRL Handbook, page 253. The current drawn from the battery when the key is closed is at most 1 ma, depending on the speed, and .02 ma when the key is open (battery life is long indeed). As for the choice of dimensions of the box to enclose the Kostless Keyer, I leave that to the builder's taste and steadiness of hand.

. . . W8MQW

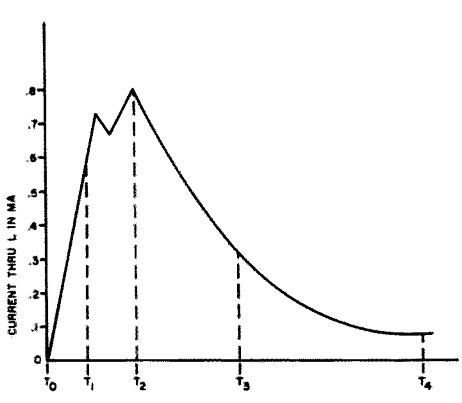
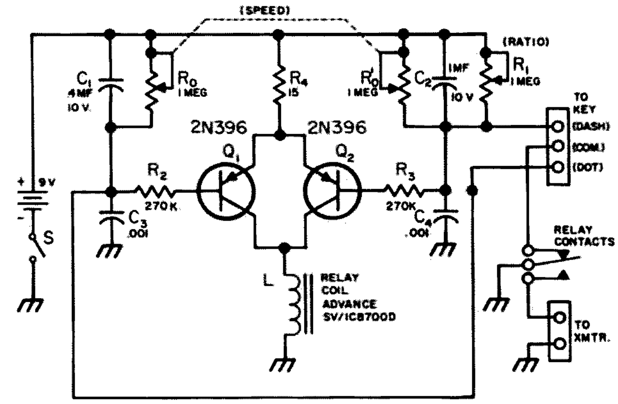
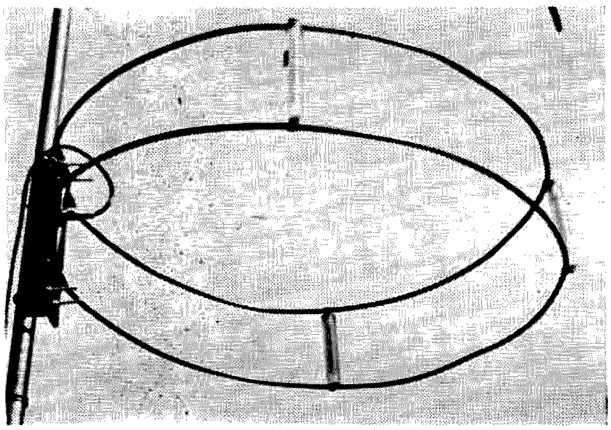


Fig. 2.

t_0: key is closed.
t_1: attains closing current.
t_2: L closes and keys transmitter.
t_3: release current, transmitter is off.
t_4: relay arm makes contact with open contact and the cycle repeats.



Kostless Keyer.



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The Double Hula

Under the influence of zoning restrictions, TVI, cliff dwelling and unsympathetic landlords, many metropolitan hams have demonstrated frenzied ingenuity in contriving new designs for compact, inconspicuous antennas. Often enough, alas, paying the price of high losses, reduced capture area and low radiation efficiency, resulting in galloping frustration in trying to combat their full sized country cousins on our crowded bands.

A recent commercial innovation that offers remarkable possibilities to the huddled ham masses of suburbia and city is the 'Hula Hoop'. This new concept of radiator has already been introduced in several publications, and is known by the more conservative title of Directional Discontinuity Ring Radiator, a unique vertically polarized antenna utilizing a *horizontal* element mounted at almost zero height above its operating ground. In principle the Hula Hoop functions like a leaky waveguide.

In its originally reported form the Hula Hoop consists of a continuously circular radiating element, the circumference of which is equivalent to a quarter wave at the *highest* operating frequency. The circular element is mounted in a plane parallel to the operating ground-plane. A section of the radiator extends at 90 degrees to the plane of the circle at the driven end to form a short vertical leg, the length of which is shown as 'h' in *Fig.* 1, and the length of which is equivalent to the height above ground. The diameter of the hoop may be expressed as 28 electrical degrees at the highest operating frequency, while the vertical leg 'h' is 2.5 degrees. The radiator may be resonated downwards in frequency by increasing the series capacitance 'C' between the terminal end of the element and ground. In practice the Hula Hoop may be tuned over a 2:1 frequency range, permitting two band operation. However efficiency decreases sharply as resonance is lowered.

According to commercial tests the Hula Hoop is capable of radiating a field strength only 3 db less than a full size quarter wave vertical operating against the same ground plane. At one half the normal frequency, when resoanted by the appropriate series capacitance, field strength drops as much as 15 db from that by a quarter wave vertical. Even this is not so bad when the efficiency of some 'loaded' verticals used successfully for mobile operation are taken as a comparison.

While physically resembling it's cousin the half-wave, horizontally radiating 'Halo', beloved of six meter mobile enthusiasts, the Hula Hoop's functional characteristics are far from similar. The quarter-wave loop, in close physical and electrical relationship to a ground-plane, results in complete cancellation of a horizontally polarized field. The discontinuity effect of the radiating elements circular con-

ȝuration causes it to act as a leaky waveıide' with a highly efficient vertically polared field.

One published construction article[3] deribes the application of the Hula Hoop for obile operation on ten meters or CB band, ilizing the car roof as an effective ground ane. This Hula Hoop is only 27 inches in ameter with height above roof (h) being a ere 3 inches. It is claimed to have outperrmed a quarter wave whip mounted on the me vehicle.

For the suburbanite the Hula Hoop brings e opportunity of low-frequency operation on e current 75 and 40 meter DX bands, withıt having to erect a vertical radiator, the ›ight and appearance of which will unleash e wrath of neighbors and local officialdom. enough real estate is available to accomodate a Hoop diameter of from nine to eighen feet, supported one to two feet above ound, the surrounding community may not 'en be aware he has an antenna. Or if they e, will conclude it to be the supporting ructure for a plastic swimming pool.

For the compact crowd, the Hula Hoop may ell be exploited on the higher frequencies, *'oviding an adequate groundplane is avail›le.* Even at 20 meters the hoop diameter is ıly a paltry 54 inches.

The author's own experiments with a carp, ten meter prototype were extremely conncing. Half a dozen stations worked on 'ound-wave reported no discernible differıce on their S-meters between the hula and comparison mobile whip. The darn thing orks.

But what of the city-dweller without a con›nient ground-plane to hook his hula to. Or 'en his country cousin who wishes to hoist the ıla to dizzy heights without compromising ; compact qualities with bulky ground-plane ements. And let it be understood, on the 'ound, or in the air, the Hula Hoop requires highly effective ground-plane, so cast out ose slender ground rods and roll out the ıicken wire, you low-frequency DX'ers.

But wait, there is a solution. At K2ICF fixed cation, where it was desired to take the adıntage of height for ten meter RACES operion over hilly terrain, top-of-the-mast operion was the dilemma. Then came the blindg inspiration for a ground-planeless Hulaoop and the Double Hula came into being.

Since the conventional Hula-Hoop perched ı its vertical leg at height 'h' above the 'ound-plane sees a mirror-image of itself in e ground from which it derives its phaseg characteristics, why not replace the mirror

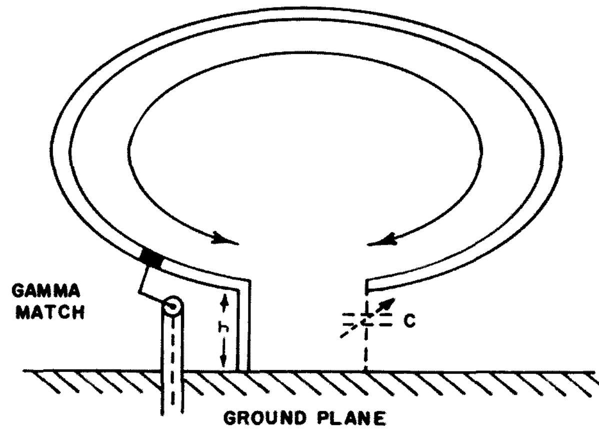


Fig. 1. Total radiator length L + h = ¼ wave at highest frequency. C = added resonating capacitor to lower frequency.

image with a physical twin. Why not, in fact, furnish a second Hula Hoop spaced 2h below the primary element and electrically connected by a common vertical leg. A doublet Hula?

No time was lost in acquiring a roll of automotive copper tubing ⅜ inch in diameter, and retiring to the basement to pound this into two parallel hoops spaced 6 inches apart by polystyrene rods. The mounting assembly shown in *Fig. 2*, was fabricated from a 10″ × × „9 ¼″ masonite board, to which the common vertical leg and hoop end were rigidly mounted with clamps made from ½″ copper strip. Variable capacitance was added to the terminal end of each hoop by 3″ lengths of copper strip extended from the mounting clamps adjacent to the vertical leg. The shell of a female coax connector was sweated to the mid-point of the vertical leg, and the center conductor connected by a short length of #14 gauge wire to a copper clamp spaced approximately 4″ along the upper hoop, to provide the required gamma match for the coaxial feedline.

The entire assembly was then wrestled to the roof of the station building (known to other family members as house) and was mounted with the traditional U-clamps to the mid-point of a rugged 12 foot mast that also supports the family TV antenna as shown in the photo.

As was expected the massive bulk of the TV antenna directly above the Double Hula had undesirable results on its radiation pattern, as apparently did the vertical mast extending both above and below the hoops, in the place of radiation. However this initial mounting did permit tune-up and matching adjustments, and close up photographing.

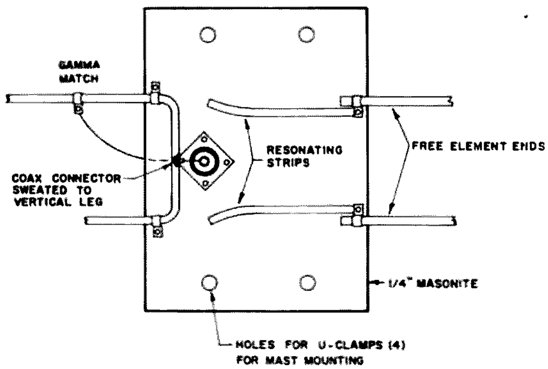


Fig. 2 Doubla Hula mounting assembly.

The assembly was resonated with a grid-dip meter by varying the proximity of the copper tuning strips to the vertical leg. Final pruning was accomplished by touching up the copper strips, using a long fibreglass rod, to obtain minimum standing wave ratio at the operating frequency of 28.7 mc. When this was accomplished the Gamma Match was adjusted to bring the swr close to 1:1.

Since initial tests indicated the Double Hula wasn't doing so well under its TV umbrella, it was then raised on an auxiliary mast section to a position located some 4 feet *above* the TV antenna. A recheck showed no significant change in resonance or swr.

But now ground wave signals were heard from New York City and Long Island some 35 miles away, as were strong skip signals from South America. Excellent contacts were had with mobiles at distances up to 40 miles using a ten watt transmitter, and locals reported improvement in signal strength over a commercial tri-band trap vertical mounted on the roof peak.

About this time, came a second blinding flash. If the Double Hula was functioning like a vertical half wave, would it work as a horizontal dipole if its plane was rotated 90 degrees, like a wheel on edge. After a struggle this new orientation was effected. Still no change in resonance or swr, and what's more it worked. Now we had the effect of a 16 ft. horizontal dipole packed into a compact wheel configuration only 27" high and 6" in length. At a pinch it could be made to work on 20 meters. But the equivalent of a 35 foot doublet would only be 54" high and 1 ft. 'long.'

Now suppose we mounted another Doubl Hula spaced 0.2 wavelengths behind the firsl could this be phased to act as a parasitic re flector. Visions of a full efficiency 20 mete beam comprising of three sets of 'ear-rings with a turning radius limited only by boon length danced through my mind. Unfortunate ly at this juncture the author ran out of time and with none foreseeable in the reason able future, decided to turn the whole concep over to those of the fraternity who have th freedom of hours to run amuck on roof-tops At least it had been proved that vertical o horizontal the Double Hula works and offer lots of opportunity for the experimentall minded, as well as practical joy for those wh are underprivileged in space.

A few words of caution. Excepting for th basic dimensions of the 10 meter hulas, th author has not attempted to determine exac dimensions for other frequencies, and thes should not be critical considering the capa bility of series capacitance resonance. How ever length of the circular elements shoul not exceed a quarter wave at the highest oper ating frequency desired, or capacitive res onance will not be possible. Height of th vertical leg (h) is approximately 3 inches fo 10 and 11 meters and may be multiplied di rectly for lower ham bands. The Q of th hula is high, and thus the bandwidth some what narrow. The Double Hula displayed broader bandwidth, and when resonant a 28.7 mc, could be operated from 28.5 t 29.3 with less than 2:1 swr. The mechanicall minded may contrive ways of tuning such an tennas remotely for wide frequency coverage

The ⅝ inch copper tubing used for con structing my Double Hula was found to b reasonably adequate in mechanical strengt for several weeks. However there is som doubt to its survival in high winds or ice storms. More rugged material is suggested fo permanent use and especially for lower fre quency versions. . . . K2IC

Bibliography

1. Electronics, January 11, 1963. "Hula Hoop Antenna's A Coming Trend." J. M. Boyer.
2. R.S.G.B. Bulletin, April, 1963. "Technical Topics A Breakthrough in Verticals?" Pat Hawker, G3VA.
3. Popular Electronics, July, 1963. "The Hula Hoop. Roy E. Pafenberg, W4WKM.

Propagation Chart

April 1965

J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7*	7	7	7	7	7	7	7	7*	7	14
ARGENTINA	14	14	7*	7	7	7#	14	14	21	21	21*	21
AUSTRALIA	14	14	7#	7#	7#	7	7	7	7	7#	14	14
CANAL ZONE	14	7*	7	7	7	7	14	14	14	21	21	21
ENGLAND	7	7	7	7	7	7#	14	14	14	14	14	14
HAWAII	14	14	7#	7	7	7	7	7*	14	14	14	14
INDIA	7	7#	7#	7#	7#	7#	14	14	14	14	14	7
JAPAN	14	7#	7#	7#	7#	7#	7	7	7	7#	14	14
MEXICO	14	7*	7	7	7	7	7*	14	14	14	14	14
PHILIPPINES	14	7#	7#	7#	7#	7#	7#	7	7	7	7#	14
PUERTO RICO	14	7	7	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	7*	7	7	7#	7#	14	14	14	14	14	14	14
U. S. S. R.	7	7	7	7	7	7#	14	14	14	14	14	7
WEST COAST	14	14	7	7	7	7	7	14	14	14	14	14

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	7	7	7*	14	14
ARGENTINA	21	14	14	7	7	7#	14	14	14*	21	21*	21
AUSTRALIA	14	14	14	7#	7#	7	7	7	7	7#	14	14
CANAL ZONE	14	14	7	7	7	7	14	14	14	21	21	21
ENGLAND	7	7	7	7	7	7#	14	14	14	14	14	14
HAWAII	14	14	14	14	7#	7	7	7	7#	14	14	14
INDIA	7	7#	7#	7#	7#	7#	7#	14	14	14	14	7
JAPAN	14	14	7#	7#	7#	7#	7	7	7	7#	14	14
MEXICO	14	7*	7	7	7	7	7	7*	14	14	14	14
PHILIPPINES	14	14	7#	7#	7#	7#	7#	7	7	7	7#	14
PUERTO RICO	14	14	7	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	7*	7	7	7#	7#	7#	14	14	14	14	14	14
U. S. S. R.	7	7	7	7	7	7	7#	14	14	14	14	7#

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	7	7	7	7	7*	14	14
ARGENTINA	21	14	14	7	7	7	7	7	14	14	21	21*
AUSTRALIA	21*	21*	21	14	14	14	7	7	7	7#	14	21
CANAL ZONE	21	14	7*	7	7	7	7	7	14	14	14*	21
ENGLAND	7	7	7	7	7	7	7#	7#	14	14	14	14
HAWAII	21*	21*	14	14	14	7	7	7	7	14	14	14
INDIA	14	14	14	7#	7#	7#	7#	7#	7*	14	14	14
JAPAN	14	14	14	14	7#	7#	7	7	7	7#	14	14
MEXICO	14	14	7	7	7	7	7	7*	7*	14	14	14
PHILIPPINES	14	14	14	14	7#	7#	7	7	7	7	7#	14
PUERTO RICO	14*	14	7	7	7	7	7	14	14	14	14	14*
SOUTH AFRICA	7*	7	7	7#	7#	7#	7#	14	14	14	14	14
U. S. S. R.	7#	7#	7	7	7	7	7	7#	14	14	7#	7#
EAST COAST	14	14	7	7	7	7	7	14	14	14	14	14

Very difficult circuit this hour.
* Next higher frequency may be useful this hou

Good: 1, 2, 4-6, 13-17, 19-26, 30
Fair: 3, 7, 9, 10, 18, 27-29
Poor: 8, 11, 12
VHF Dx: 4, 13, 14, 30

TRI-EX TOWER CORPORATION OPENS FACTORY-DIRECT PROGRAM

Tri-Ex Tower Corporation has inaugurated a new policy of factory-direct consumer sales, it was announced today.

"Tri-Ex has always been dedicated to building the best towers available anywhere at any price," said A. J. F. Clement, W6KPC, president. "Now we will also offer the very best in service to Tri-Ex tower owners.

"By factory-direct sales a number of advantages will be accrued by new tower owners. First, each factory-direct order is assured of faster service. Second, the very finest professional engineering assistance is immediately available. Third **ALL** Tri-Ex towers are now *hot-dipped galvanized* after fabrication (rust-free), at **new lower prices,** (financing available). Fourth, it is well known that Tri-Ex Tower Corp. engineered and developed the crank-up tower from its infancy. Research and development in the crank-up tower field continues unabated as evidenced by the new (LM-470) seventy foot free standing tower recently marketed. The LM-470 is a minimum cost installation, requiring only a single base mount.

"Since most key personnel at Tri-Ex are active Radio Amateurs, they are very well qualified to assist you in selecting the most appropriate tower to fit *your* particular requirement."

The below listed members of the Tri-Ex staff are always available to answer any questions that you may have.

Martin Blackstone, WA6MFY/VR30
Clyde Blyleven, WA6ONZ
Frank Clement, W6KPC
John Hultquist, W6QMC

Contact us now for your **free catalog** describing Tri-Ex's complete line of free standing towers, guyed telescoping towers, and fixed height towers. Write to Tri-Ex Tower Corp., P.O. Box 298, Tulare, Calif., or call (209) 686-3411.

Part of Swan main assembly line.

HF SSB Transceivers

Two years ago we ran our first sideband transceiver special section in 73. The reader response was so enthusiastic that I decided to repeat the section every year. Then, last year, with the amateur equipment sales at a ten year low due to the panic over the ARRL Executive Committee's submission of RM-499 to the FCC, there seemed to be little need for a buying guide. Things look much better this year. Quite promising. 16% of our readers told us that they intended to buy a sideband transceiver in the near future. That's a lot of transceivers.

	MODEL	DATE RELEASED	BASIC PRICE	FINAL TUBES	PEP INPUT	80 METERS	40 METERS	20 METERS	15 METERS	10 METERS	OTHER COVERAGE	SIDEBANDS
COLLINS	KWM-2	1960	1150.	2)6146A	175	3.8 - 4.0	7.0 - 7.4	14.0 - 14.4	21.0 - 21.6	28.5 - 28.7	14.8 - 15.0	both
DAVCO	DR-30 DT-20	10/64 4/65	700	8117	200	3.5 - 4.05	7.0 - 7.55	14.0 - 14.55	21.0 - 21.55	28.0 - 30.05	note *1	both
DRAKE	TR-3	6/63	550.	3)12JB7	300	3.5 - 4.1	7.0 - 7.6	13.9 - 14.5	21.0 - 21.6	28.0 - 29.7	- - - -	both
EICO	753	NA	k 180. w300.	2)6DQ6B	180	3.49-4.07	6.97-7.33	13.89-14.41	- - - -	- - - -	- - - -	note *2
GALAXY	III	4/64	350.	2)6HF5	300	3.5 - 4.0	7.0 - 7.5	14.0 - 14.5	- - - -	- - - -	- - - -	both
GALAXY	V	7/64	470.	2)6HF5	300	3.5 - 4.0	7.0 - 7.5	14.0 - 14.5	21.0 - 21.5	28.0 - 29.0	28.5 - 29.5 acces.	both
HALLICRAFTERS	SR-150	11/62	650.	2)12DQ6B	150	3.5 - 4.0	7.0 - 7.5	14.0 - 14.5	21.0 - 21.5	28.0 - 30.0	- - - -	both
HALLICRAFTERS	SR-160	11/63	350	2)12DQ6B	150	3.5 - 4.0	7.0 - 7.5	14.0 - 14.5	- - - -	- - - -	- - - -	*2
HEATH	HW-12, 22, 32	5/63 7/63	kit: 120.	2)6GE5	200	3.8 - 4.0 HW-12	7.2 - 7.3 HW-22	14.2 -14.35 HW-32	- - - -	- - - -	- - - -	*2
NATIONAL	NCX-3	1/63	370.	2)6GJ5	200	3.48-4.02	6.98-7.31	13.88-14.42	- - - -	- - - -	- - - -	*2
NATIONAL	NCX-5	10/64	685.	2)6GJ5	200	3.5 - 4.0	7.0 - 7.3	14.0 - 14.5	21.0 - 21.5	500kc. seg. 1 xtal. incl.	- - - -	both
SBE	SB-34	12/64	395.	2)6GB5	135	3.775-4.025	7.05-7.30	14.1 -14.35	21.2 - 21.45	- - - -	- - - -	both
SWAN	350	7/64	395.	2)6HF5	400	3.5 - 4.0	7.0 - 7.5	13.85-14.35	21.0 - 21.5	28.5 - 29.0	- - - -	*2
SWAN	400	1964	395.	2)6HF5	400	3.4 - 4.0	7.0 - 7.4	14.0 - 14.4	21.0 - 21.6	28.0 - 29.8	WWV	both
TRANSCOM	SBT-3	3/65	300.	2)8042	165	3.78-4.01	7.18-7.32	14.13-14.36	- - - -	- - - -	- - - -	*2

*1 - Davco has 9.5 - 10.05 Mc WWV on receiver; 50 - 50.55 on both; 2 positions on both for 4 - 54 Mc.
*2 - LSB on 80 and 40; USB on 20; where 15 and 10 are included, mode is USB.

Those of you that have an April 1963 issue of 73 handy can whip it out and compare it with this one. It is very interesting to see what changes have come about during the past two years.

Starting at the top of the list I find that Collins is still selling their KWM-2, originally brought out in 1959. Six years production on one model is a recent record, isn't it? Next we find Davco. At long last, the ingenious Davco receiver is in production. The last I heard they had finally stopped pushing the state-of-the-art ahead in design and were shipping their first production units. The transmitter half of the combo is still a few months off, I believe. My impression of the receiver was that Jim Lovette K4BXO was not going to sell the thing until he had crammed something like the 75A4 into a 3 x 5 file box, transistorized.

The Drake TR-3, first announced in our transceiver section in 1963, has proven to be a real winner. It certainly had a lot to do with more and more five-band transceivers coming on the market. Bob named it after his Triumph TR-3. I think Bob must have a new Triumph because I understand they will soon announce a new model transceiver, the TR-4.

The Elmac ATR-4 never really materialized. One of the fellows that works here has one, but I haven't seen any others around.

The Hallicrafters SR-150, introduced in 1962, is still going strong and has been joined by the SR-160, a three-bander. The FPM-200 was a nice rig, but I guess it was too expensive for us hams.

The Heath transceivers are now history. Their first unveiling was in our transceiver survey.

National followed up their NCX-3, which had just barely come out in 1963, with the NCX-5 five-bander and a beaut of a linear. We'll run a special linear section later on for you.

Sideband Engineers is still going strong. Their SB-33 made quite a hit and their SB-34 seems to be doing it all over again.

Sonar. Hmmm. . . I think they have settled into selling commercial units and are not really trying to do much ham business. I haven't heard anything from them in the last two years.

Swan, the one who started this whole thing, is still giving everyone else in the field a hard run for the customers with their new Swan-350 with five bands and a $400 price tag.

Transceivers Inc. Their imitation Swan transceiver never actually made it into production.

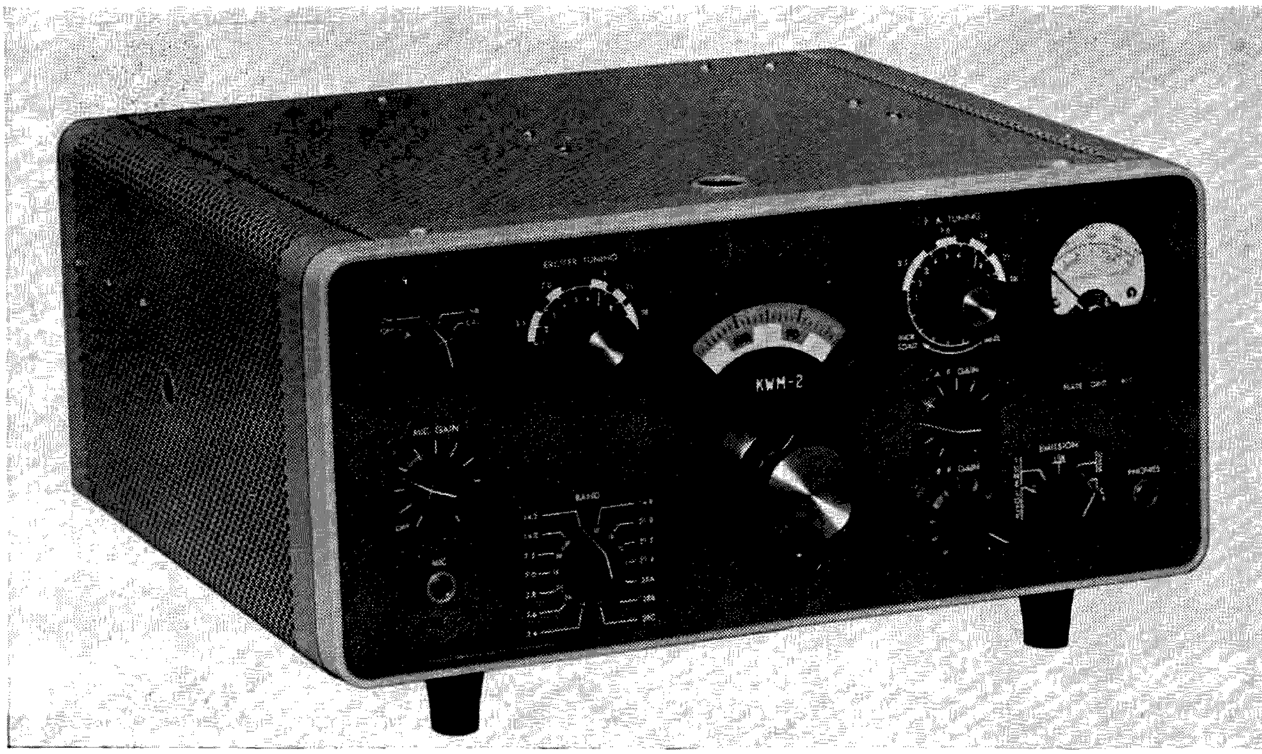
Galaxy has a new one out, the V. You'll read more about that one in my review of it elsewhere in this issue. Their amazingly low price has not hurt their popularity one bit.

While three manufacturers have dropped out of the transceiver field, only two have recently entered it: Eico and Transcom.

Sideband is here . . . it has grown up. Our recent survey showed that 51% of 73's readers are on SSB. And 35.5% have a rig in their car. Got yours yet?

1st IF, Mc.	2nd IF, Mc.	HEIGHT	WIDTH	DEPTH	WEIGHT	VOX	100 Kc. CAL	S METER	SIDEBAND GENERATION	DELTA or OFFSET TUNING	DIAL CALIB. Kc.	MOUNTING BRACKET	AC SUPPLY	DC SUPPLY	TOTAL PRICE	
2.955-3.155	.455	7	14-3/4	14	18	yes	yes	yes	Collins mech.	acc.	1	120.	115. 168.	12V 200. 28V 470.	1468.	COLLINS
2.405-2.955	.455	4 each	7-1/8 each	DR-30: 6 DT-20: 9	9 11	yes	yes	yes	filter	*4	1		incl.	incl.	700.	DAVCO
9.0	- -	5-1/2	10-3/4	14-1/2	16	yes	yes	*3	separate xtal filt.	acc.	1	7.	80.	130.	786.	DRAKE
5.2	- -	5-1/2	14	11-1/4	25	yes	acc.	yes	xtal	± 10	NA	incl.	?	?	?	EICO
9.0	- -	6	10-1/4	11-1/4	13	$25	$20	yes	xtal	acc.	5	8.	80.	120.	477.	GALAXY
9.0	- -	6	10-1/4	11-1/4	13	$25	$20	yes	xtal	acc.	5	8.	80.	120.	598.	GALAXY
6.0 - 6.5	1.650	6-1/2	15	13	17-1/2	yes	yes	yes	xtal	RIT	1	40.	100.	110.	789.	HALLICRAFTERS
5.2	- -	6-1/2	13	11	13-1/2	acc.	acc.	yes	xtal	RIT	5	15.	100.	110.	500.	HALLICRAFTERS
2.305	- -	6-1/4	12-1/4	10	15	yes	$9	yes	xtal	no	2	incl.	40.	60.	180.	HEATH
5.2	- -	6-1/16	13-5/8	11-5/8	25	yes	acc.	yes	xtal	no	5	incl.	110.	120.	490.	NATIONAL
6.02	3.5	6-5/16	13-5/8	11-5/8	26	yes	acc.	yes	xtal	± 5	100cyc.	incl.	110.	120.	805.	NATIONAL
.455	3.225	5	11	10	18	acc.	acc.	yes	Collins mech.	± 1	5	12.50	incl.	incl.	408.	SBE
5.174	- -	5-1/2	13	11	17-1/2	$35	acc.	yes	xtal	no	5	20.	85.	130.	545.	SWAN
5.174	- -	5-1/2	13	11	17	acc.	yes	yes	xtal	no	2	20.	85.	130.	620.	SWAN
5.1	- -	4-3/8	11-3/8	8-3/4	10	PTT only	no	yes	xtal	no	5	3.50	140.	100.	403.	TRANSCOM

*3 - 2nd Drake meter indicates "S" units on receive and ALC on transmit.
*4 - Davco's separate receiver and transmitter allow either transceive or separate operation.



KWM-2

Collins Radio
Cedar Rapids, Iowa

Unmatched for versatility, dependability and mobility, the Collins KWM-2 maintains a reputation of outstanding performance in mobile and fixed station applications.

The KWM-2 power input is 175 watts PEP on SSB or 160 watts on CW. It transmits on voice or CW with a nominal output of 100 watts for complete coverage on 80 through 10 meters. Crystals are provided for all HF bands except 10 meters, where one crystal is supplied with provision for two additional crystals.

The transceiver is finished in light gray enamel with a simulated leather front panel to match the S/Line.

The first available amateur mobile SSB transceiver was in the Collins KWM series. The KWM-2 continues to lead the field with the following features: Filter type SSB generation providing unsurpassed performance on both transmit and receive.

Automatic load control which keeps the signal level adjusted to its rated PEP, resulting in an increase in average talk power.

Inverse rf feedback which improves linearity and reduces distortion products, giving the cleanest signal on the air.

Permeability-tuned Variable oscillator with linearity and stability providing the best frequency calibration available.

One kc division on all bands, eliminating frequency searching and allowing you to meet anyone on sked, on any band 80 through 10 meters.

Compactness and efficiency of the KWM-2 are achieved through Collins' advanced design of having all tuned circuits and several tubes function in the dual role of transmitting and receiving. The same oscillators, mechanical filter and rf amplifier serve both the transmitter and receiver. CW break-in and monitoring sidetone circuits are built in.

Easily accessible controls on the front panel of the KWM-2 include the OFF-ON-NB-CAL SWITCH, EXCITER TUNING, ZERO SET, PA TUNING, LOADING, MIC GAIN, BAND SWITCH, AF GAIN, RF GAIN, EMISSION and METER SWITCH.

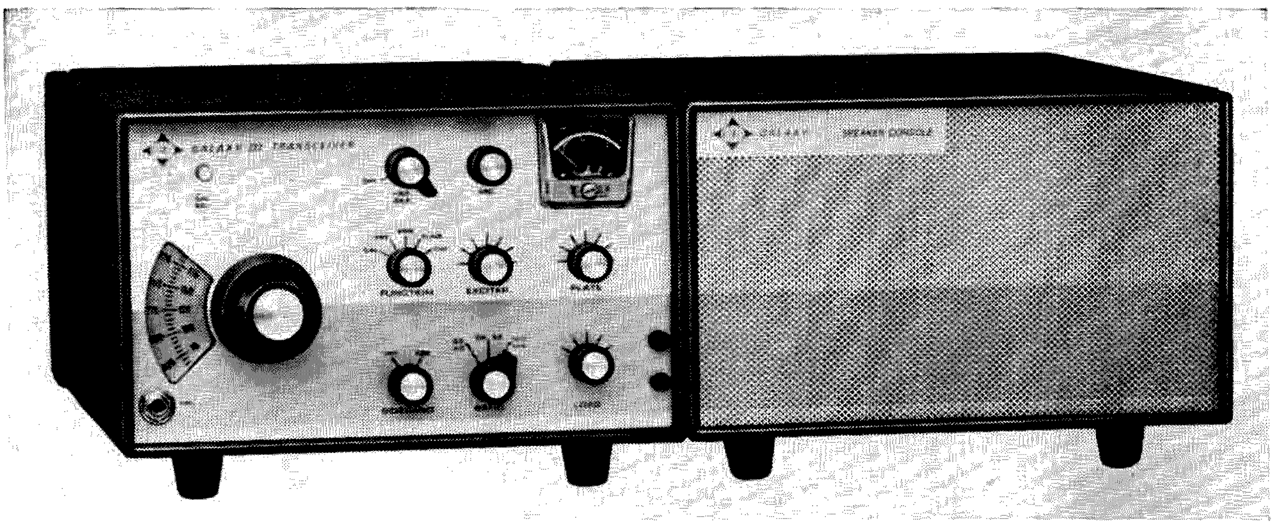
The KWM-2A is an extended frequency version of the KWM-2 for MARS (Military Affiliate Radio Service) and military applications. The KWM-2A has an additional crystal board permitting the operator to add 14 crystals to cover frequencies outside the amateur bands. The KWM-2A has a front panel switch and indicator, allowing instant switching between the two crystal boards.

TR-3

R. L. Drake Co.

Miamisburg, Ohio

The Drake TR-3 is designed to be a COMPLETE SSB transceiver. All ham frequencies, 80 through 10 meters are covered completely with all crystals furnished. Included also, are both sidebands, selectable as desired, dual metering of transmitter plate, and ALC and receiver S meter. The linear permeability tuned PTO covers 600 kc on each range. It is resetable to less than 1 kc if the dial is calibrated at the closest 100 kc. Amplified AGC is provided for receiving and amplified ALC is used to minimize flat-topping on SSB transmission. The 100 kc calibrator is built in. Vox, push to talk SSB, controlled carrier AM (260 watts PEP), and CW (260 watts PEP) functions are provided. 300 watts PEP input on SSB provides more than adequate output for driving the largest linear. This extra power was provided because a transceiver is often used as a complete station, mobile or portable, with antennas that are less efficient than in home stations. Accessories available are the AC-3 Power Supply for 120 or 240 volt, 50-60 cycle operation; the DC-3 Power Supply for 12 volt DC battery operation; the MMK-3 Mobile Mounting Kit; the MS-3 Speaker Assembly (provides space for AC-3 Power Supply); and the RV-3 separate PTO, speaker and power supply enclosure. The RV-3 provides independent transmitting and receiving frequency control for working DX and other independent uses.



III and V

The Galaxy III and V transceivers have many features. They are easily adapted to mobile operation because of their small size. They use the EZ Vue dial for minimum visual read-out error in mobile use. Their receivers are very sensitive: better than 0.5 μv for 10 db S/N. They have dual attack and release AVC to make the receiver virtually block proof. They have eight to ten db of ALC for increased power and minimum flat-topping and distortion. They have selectable upper and lower sidebands. They are manufactured under the strictest possible quality control. They have shifted carrier CW for best operation. Accessories available include a Deluxe console at $99.95 with 24 hour clock, SWR bridge, speaker, phone patch and a meter calibrated in SWR and VU. The Remote VFO is $59.95 gives full range coverage. The Standard Speaker Console is $19.95.

Galaxy Electronics

10 South 34th St.

Council Bluffs, Iowa

SR-150 and SR-160

Hallicrafters Co.

5th and Kostner

Chicago, Ill.

The Hallicrafters Model SR-150 Transceiver is a precision-built, compact, high-performance radio equipment of advanced design. This transceiver utilizes 19 tubes and a dual conversion *if* to provide for the transmission and reception of single-sideband (SSB) and continuous wave (CW) signals on the 80, 40, 20, 15, and 10 meter bands. The SR-160 is a three band single conversion transceiver covering the 80, 40 and 20 meter bands. Both the SR-150 and SR-160 feature AALC for improved talk-power and third and fifth order distortion products down 30 db.

The versatility this equipment permits it to be operated as a fixed station or as a mobile equipment. A 117-volt, 50/60-cycle, AC power supply, complete with speaker is available for fixed-station use; a 12-volt DC power supply and a mobile mounting rack are available when the transceiver is to be used in a mobile configuration.

An advanced feature of these transceivers is the Receiver Incremental Tuning (RIT) control. This control enables the operator to unlock the receiver frequency and tune the receiver approximately two kc either side of the transmitter frequency. Flipping the RIT switch off automatically returns the equipment to the transceiver condition.

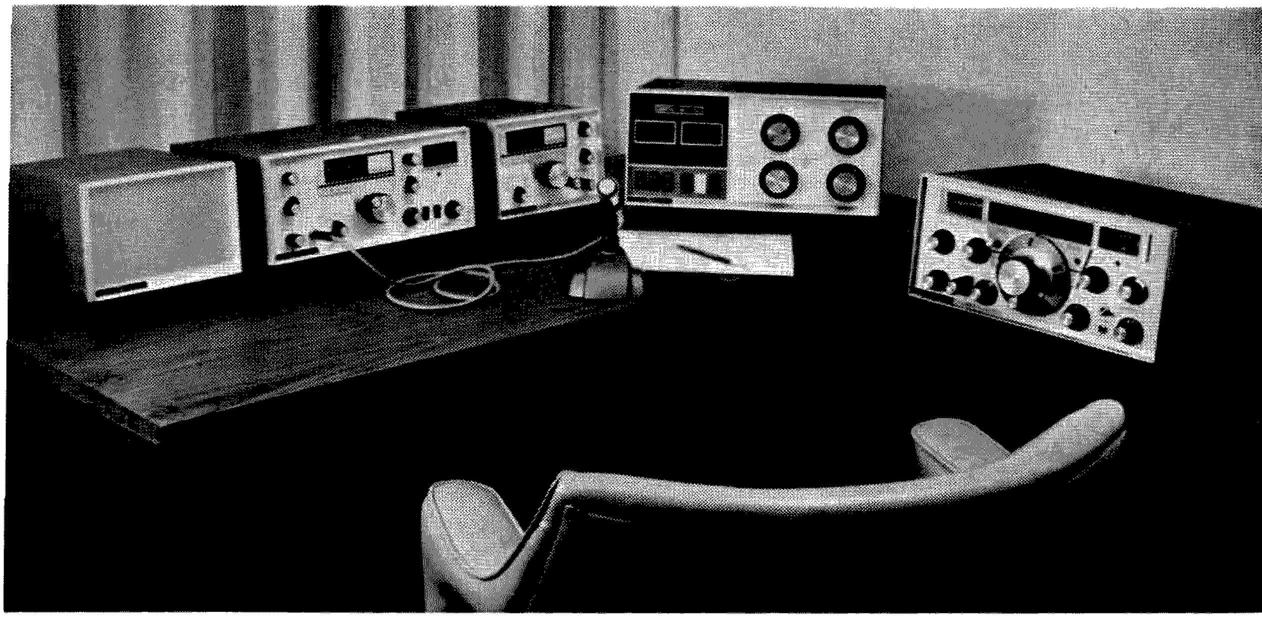
HW-12, 22, 32

Heath Company

Benton Harbor, Mich.

The three Heath single band SSB transceivers are neatly styled units providing complete transceiving facilities suitable for mobile or fixed operation. Features include a deluxe fourteen tube superheterodyne circuit for receive that provides a sensitivity of 1 microvolt and selectivity of 2.7 kc at 6 db and 6.0 kc at 50 db. Drift is less than 200 c/hour after warm up. Transmitter final input is 200 watts PEP. The VFO operates on 1.5 to 1.8 mc. PTT and VOX are built in, and provision for a linear amplifier is provided. An optional 100 kc crystal calibrator is available.

Assembly is easy with over 90% of the components mounting on a heavy circuit board. A pre-cut, cabled wiring harness and easy-to-follow instructions further simplify assembly. Alignment is easy as all critical stages are pretuned. The gimbel mounting bracket is included.



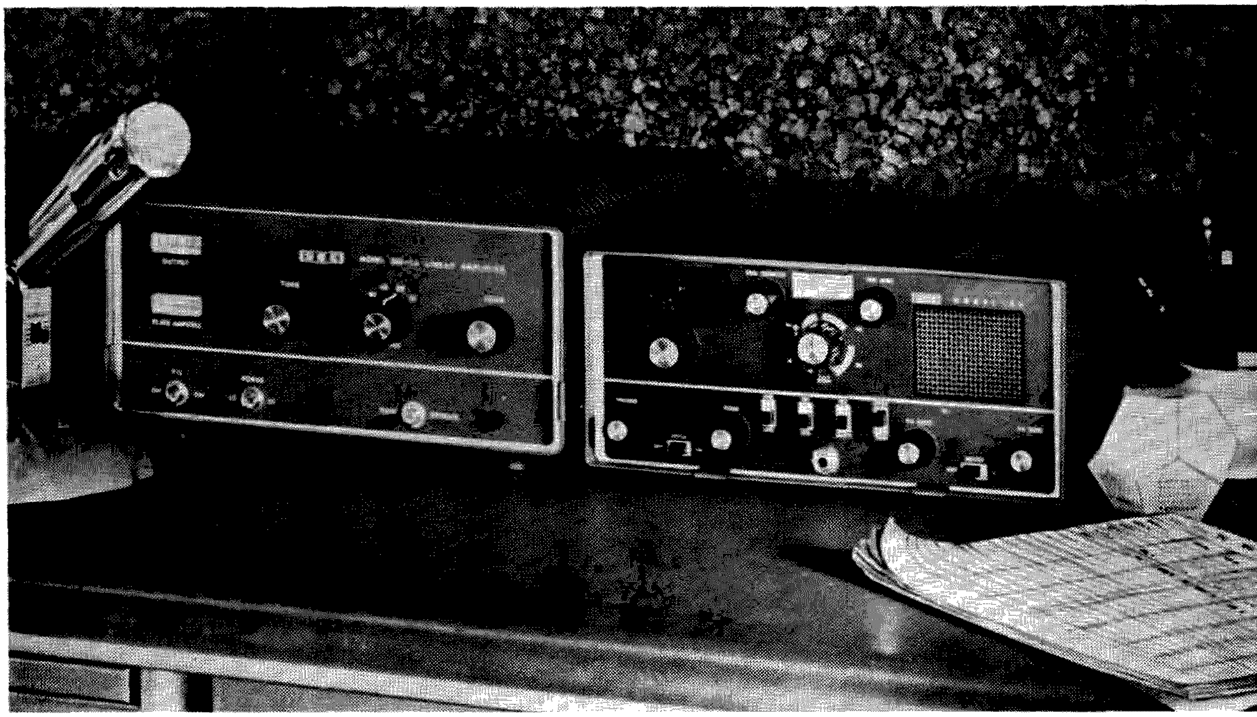
NCX-3, NCX-5

The NCX-5 is National's 5 band SSB transceiver. It has digital counter tuning readout accurate to 1 kc with dial calibration to 100 cycles. The NCX-5 uses a solid state VFO with no warm-up drift; it is virtually unaffected by large variations in input voltage. The upper and lower sidebands are switch selectable with no retuning. National's new 6.0218 mc 8 pole crystal lattice filter has a shape factor of 1.7:1 and a 6 db bandwidth of 2.8 kc. The Transceive Vernier control allows ±5 kc receiver separation from the transmit frequency. 10 db of ALC minimizes flat-topping. Among other meatures are two receiver rf stages to provide 0.5 μv sensitivity for 10 db S/N ratio; separate AM detector; VFO input for optional VFO console; choice of built-in VOX, PTT or MOX (manual control); and break-in grid block CW.

The NCX-3 Triband SS transceiver provides complete coverage of the 80, 40 and 20 meter phone and CW bands, VOX or PTT, grid block break-in CW, product detector for CW/SSB and triode detector for AM and geared planetary tuning dial. The handsome front panel is anodized for maximum protection against wear.

National Radio Company

Melrose, Mass.



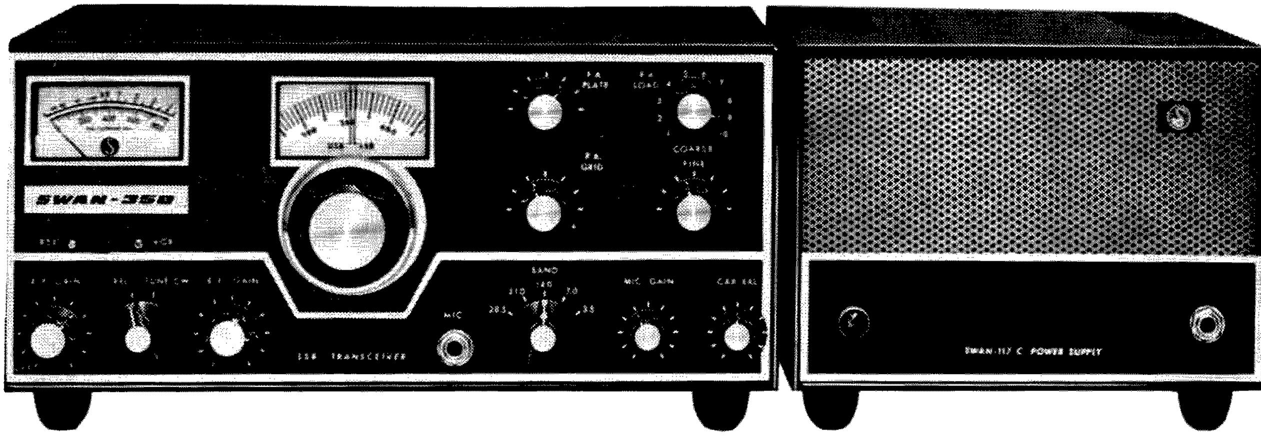
SB-34

Sideband Engineers

317 Roebling Rd.
S. San Francisco, Calif.

The SB-34 is a four band SSB transceiver using 23 transistors, 18 diodes, 1 varactor, 1 zener diode and three tubes. Using transistors so extensively results in lower current drain, cooler operation, longer life and small size. Performance is equivalent to or better than comparable tube-type transceivers. For example, receiver sensitivity is 1 μv for 10 db S/N. 2.1 kc selectivity is provided by the Collins mechanical filter.

The SB-34 uses bilateral amplifiers and mixers throughout, on both transmit and receive. They operate by controlling the direction of amplification. This reduces circuit complexity, reduces the number of materials required, simplifies adjustments and eliminates the need for transmit-receive relays. Tuneup and operation of the SB-34 is simple; a unique permeability tuning slug mechanism eliminates separate coil sets for each band. An ingenious Geneva movement combines bandswitch and exciter tuning functions in a single knob. The loudspeaker and both ac and 12 v dc power supplies are built in. Drift is very low: less than 100 cycles in any 30 minute period under any normal ambient condition.



350 and 400

Swan Electronics

Oceanside, Cal.

Swan Electronics is currently marketing two 5 band transceivers. Each is rated conservatively at 400 Watts PEP input. These models, the 350 and the 400, are outgrowths of the original SSB single band transceivers and the very popular model 240 tribander.

Swan's outstanding reputation for high performance quality and dependability at a reasonable cost has been built over a relatively short period and these two additions to the line will undoubtedly enhance this reputation.

The 400 is the deluxe model in the Swan line. An external VFO with no built-in heat source provides exceptional stability and calibration. Warm-up drift is negligible and the unit is rockstable after the first few minutes. This unit is readily adaptable for use on Mars frequencies or commercial frequencies without loss of ham bands.

The standard model 350 transceiver includes all necessary features for either fixed or mobile operation on all bands and permits inclusion of non-essential but nice "features" at nominal kit cost. It features the same high quality and reliability of the 400 and other Swan transceivers, and it is priced reasonably.

IoAR News

Something new has been added for IOAR membership! A new low membership fee has been announced as yearly dues of the IOAR. There's something tangible in it for you, too. Here's how it works—for $7.00, now you can have an active part in supporting the IOAR as a full member and receive 73 Magazine, too. There's no distinction as to membership levels dependent upon the class of your amateur radio license.

How about those that are already IOAR members and receive the magazine and want to get in on the combined arrangement? Easy! Send in your $7.00 for IOAR and 73, and your membership will be extended through your current 73 subscription and then will run concurrent with the added 12 issues of the magazine. (No adjustments either way, please.)

Now—how about the fellow who is a current subscriber to 73 only? Send in your $7.00. Your IOAR membership will start immediately and will remain through your present subscription until expired and then will automatically continue for the additional 12 issues of 73 until the concurrent expiration of membership and 73. All conditions soon come into adjustment. We call it "togetherness." Simple, isn't it?

O. K. fellows, now let's build, Build, BUILD MEMBERSHIP! (Later, arrangements are anticipated to be worked out on a club affiliated membership basis.) Let's get that treasury swelling so we can allocate emergency funds to cover amateur radio contingencies as they occur. IOAR wants to be ready to assist where necessary.

If you didn't already recognize it—it is a fact that 73 is the official organ of the IOAR. Not the entire magazine, but those number of pages carrying the IOAR News and other features pertinent to IOAR.

The constitution and by-laws are forthcoming. They are about ready to be released through our own official news media (IOAR News that is) in 73 Magazine. All IOAR members will have a chance to ratify the rules. Unlike other organizations of similar intent, IOAR will be democratic. Let us all keep it that way. It may take a little longer, but members will have their say.

The IOAR is not and will not become a publishing house. Its prime interest will continue to be devoted to the amateur radio fraternity. 73 Magazine is quite capable of disseminating all official IOAR matters with its national and international wide range of distribution reaching IOAR members and nonmembers alike all over the world. In this connection, it is sound business management to captivate the largest field of absorption (73 is widespread and influential) on matters of the IOAR to all interested amateur licensees of all classes whether they are members or not.

Get set soon for a voluminous and complex FCC proposal for rule making affecting, to some degree, most all classes of amateur radio licensees. Some of you won't like it. It is anticipated that a sizable minority group will not be affected (again).

Looking on all sides of the problems and having had measured the RM-499 official file of dissenters, the proposal probably won't be identical to this mad, mad, mad approach. But don't be too self assured—read the fine print carefully—rumor—strictly rumor has it that the old guard has rallied again. Don't rule out the possibility that the W4RLS Foy Guinn petition may have been studied with all of its thousands of Joiners in Petition. The FCC certainly has had enough elapsed time to ponder and come up with something really good (we hope) as opposed to the one organization's approach over a year ago.

A lot of you remember FCC's Docket 9295 of the 1949 era. The ARRL, not content with the commission's "Basis and Purpose" and a truly realistic incentive licensing plan, chose to hack away for the protection of the old Class A to avoid their losing operating privileges because the FCC proposed placing them into the General Class bracket (I wonder what it will be this time). Well—that was a long time ago—the battle won but the war was lost—could the ARRL have been remiss?

If you support or disagree with the "new approach" (The FCC proposal), carefully observe the deadline date for filing and get those good reasons of yours off to the FCC in an ORIGINAL plus fourteen (14) additional copies substantiating your comments pro or con.

Yes—the IOAR has stamps. They are a brilliant orange-red and self-adhesive. Perhaps you have seen them. Request your stamps today with your membership application—JOIN IOAR—BOOST IOAR—PUSH IOAR.

E. M. Schaad WA4PDX/W9A1Y
Director

John Sakellakis W8GXU
2339 South Taylor
Cleveland 18, Ohio

A Versatile Code Monitor

with bonus features—

As every CW operator knows, a code monitor independent of the station receiver helps in clean sending and in maintaining the receiver tuned to that always elusive signal. During my ten years on CW, I have tried every published circuit on monitors without finding one to completely satisfy me. Most required stealing power from the receiver, practically all were dependent on some connection to the transmitter and others utilized plug-in coils to cover more than one band. I finally decided to build my own and the result is a transistorized self powered monitor that works on all bands without tuned RF circuits and needs no attachments or proximity to the transmitter. It can be used as a field strength meter, code practice oscillator, in the home, the car or in the field. The cost of all new components except the meter runs well under ten dollars.

The Circuit

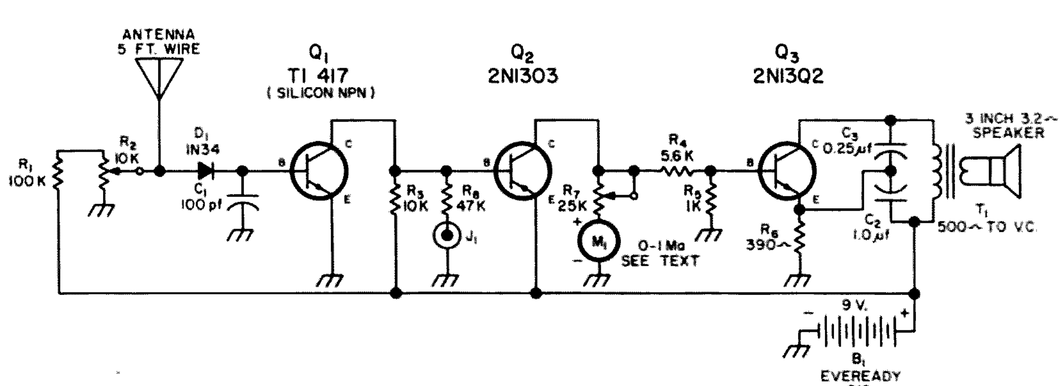
The complete schematic is shown in Fig. 1. The heart of the circuit is the complementary high gain DC amplifier made up of Q_1 and Q_2, which precedes the Colpitts oscillator Q_3. Potentiometer R_2 sets the operating point of the DC amplifier to a threshold condition with diode D_1, Q_1 and Q_2 barely conducting. Under these conditions the collector of Q_2 rests at near ground potential. The oscillator transistor Q_3 receives its base bias from a tap on the Q_2 collector load made up of R_4 and R_5. With the collector of Q_2 sitting on ground, the oscillator is biased off. Interception of RF energy by the five foot length of wire used as antenna, causes additional current to flow through D_1 and the base of Q_1. This current is amplified by Q_1 and Q_2, resulting in saturation of Q_2, which now has its collector at near supply voltage. Q_3 now is properly biased and oscillates. With the values shown the frequency is 500 cycles, a very clean sine wave, and the volume is sufficient to annoy the XYL.

A meter in series with potentiometer R_6, placed between the collector of Q_2 and ground, adds a field strength function to the unit. Since the meter is at the output of the DC amplifier a rather inexpensive movement can be used. I use a 0-1 ma meter, but anything up to 10 ma can be used.

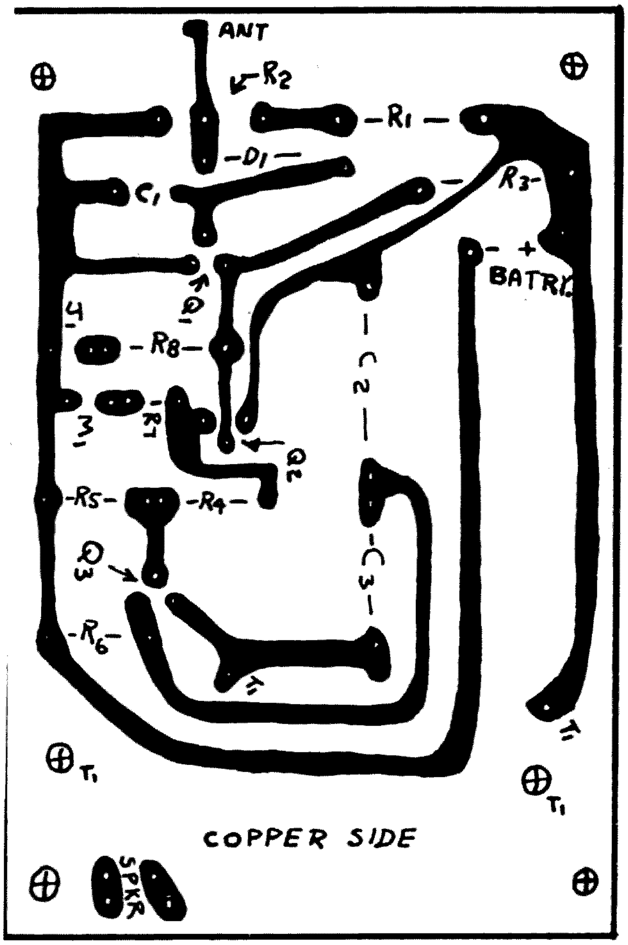
A 9-volt transistor battery is used to powei the unit. No ON-OFF switch is used. With the oscillator off, the drain on the battery is only 1/10 ma., and the battery should last its shelf life.

Construction

A home made printed circuit board is used to mount all components except the two potentiometers, jack, meter, and speaker which mount on the face of 5″ × 5″ × 7″ box. The printed circuit pattern is shown to size in Fig. 2. Lacking a printed circuit board, any con-



Versatile Code Monitor



Printed circuit layout.

construction method can be used. Since no RF tuned circuits are used, no particular care need be exercized in layout of components. Make sure that the right output tap is used for the speaker impedance you are using.

Operation

To use the monitor, advance pot R_2 until some broadcast band chatter is heard on the speaker, back off a hair, and you are ready to monitor your transmissions. With my 100 watt transmitter in tune position, positive, chirpless keying is obtained on all bands. If you like QRP, use a longer hank of wire as antenna.

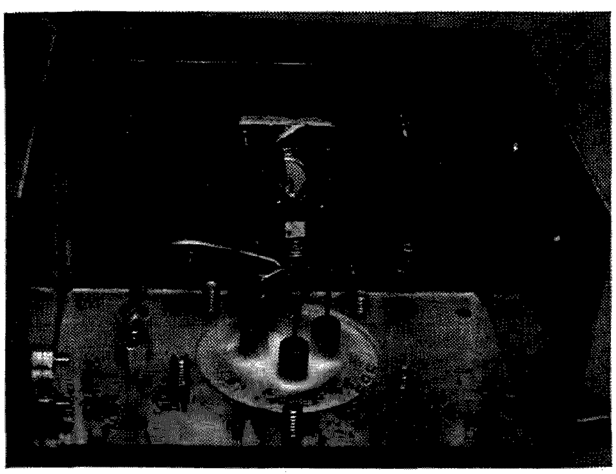
To use the field strength meter, advance pot R_2 until the oscillator is on. Adjust pot R_6 to bring the meter full scale. Leave R_6 alone and use R_2 as the only sensitivity control. Keep the meter reading below 7/10 of full scale. By carefully adjusting R_2, it is possible to obtain audible changes from the oscillator as the transmitter is tuned for maximum output. This feature may be used by the blind amateur as a means of tuning the transmitter.

After you go QRT, plug in a key in jack J_1 and let the harmonics practice for that long awaited novice license.

. . . W8GXU

Hank Olson W6GXN
Stanford Research Institute
Menlo Park California

Calibrated Noise Generator for 432



RF Circuitry.

Now that the lid is off the 420-450 mc band as far as power restriction goes, many hams are reaching for the moon-bounce mode on this band, where available transmitting tubes can be used. Groups of 4X150's, 4X250's, 2C39's and such tubes can actually be made to work at 432 mc at the kilowatt input level. Also, the receiver problem isn't quite as hectic as it is at 1296 mc; nuvistors or WE 416B tubes will perform fairly well. Even paramps can be constructed more easily at 432 mc than at 1296 mc, because the pumping source can be of a lower frequency. It sounds as if it is going to be easy to get on, doesn't it, but don't anticipate the world-wide lunar QRM yet—there are some things to be done.

The hams who are going to be successful at 432 moonbounce, are the hams who equip themselves to make *measurements*. The report, "It didn't seem to work" at the termination of a long, inspired ham construction project, tells one nothing. Since there are many pitfalls, the guy who can instead say: "it doesn't have a low enough sputter ratio" is the one who will persist and, after fixing the trouble, be on "states-worked" page.

As pointed out in previous articles—the temperature-limited noise diode is the best tool for measuring the sensitivity of one's receiver. The measurement made with this device is "noise-figure" or "noise-factor" and this is the magic number by which you can compare your VHF or UHF receiver with Joe's down the street, or Sam's in Massachusetts. These measurements will be comparable between any two receivers because bandwidth, type of detector, and other miscellaneous features (different for each receiver) do not affect the measurement, if it's carefully made (that is, if one's measurement of 3 db power increase, when the diode is turned on, is true).

Past amateur articles on noise-diodes and their use in noise-factor measurement have

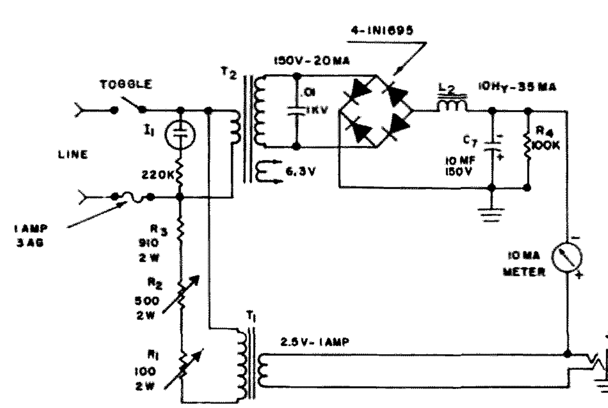


Fig. 1. Power supply.

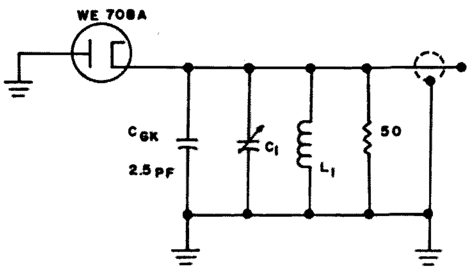


Fig. 2. Basic noise generator circuit.

only shown how to construct units for up to about 200 mc. The noise generators described previously, for amateur use, have used the 5722, the diode wired 24G (3C24), or the diode wired 801A, as their tungsten-filament diodes. The 15E and 01A have also been used occasionally as diode-wired triodes, too. Commercial UHF noise generators use a variety of tungsten-filament tubes, all of which are a bit expensive for most hams. If you can lay your hands on one of these tubes, used or otherwise surplus, by all means employ it in your noise generator. Table I is a list of such gems.

Philco:	L1262A
RCA:	R6212
Bendix:	6144
Marconi:	CV2171

Table I

The tube I used is a triode, a Western Electric 708A, originally designed for grounded-grid UHF amplifier service. The grid and filament are used as the diode elements, ignoring the plate altogether; the plate, if used, could only increase transit time and shunt capacity. The tube is used, as it was intended to be used, with the metal shell (grid) grounded. The 50 Ω load is connected in the filament cricuit; the filament power is fed in by means of a concentric inductor, which also tunes out the stray capacity of the tube.

C_1, a small "tweaker," adds in a tiny additional capacity to make adjustment to 432 mc easier; it makes tuning to anywhere in the 420 to 450 mc band possible. L_1 is constructed of a 1¾" length of ⅛" copper tubing and has a piece of No. 20 teflon insulated wire inside it. The use of teflon insulated wire is only necessary because teflon will withstand the heat of soldering.

The effective circuit, then, is as in Figure 2.

At 432 mc, if $Cgk + C_1 = 3$ mmfd, then L must be 0.04 μh to be parallel resonant. The reactance of either $Cgk + C_1$ or L_1 is about 100 Ω, so the system has a Q of ½, and hence will be rather broad in its noise output spectrum—just as we want it to be.

The WE 708A tube was recently available from a Los Angeles surplus emporium at the price of 39 cents each or ten for a dollar. We bought a buck's worth, figuring some would be NG, but all were perfect and saturated well. One was lost in initial test, when we applied too much filament voltage; it was subsequently hack-sawed open to find out the details of its construction and to confirm connections. The details learned are presented in Figure 3 along with its saturation curve.

The filament is a single, fine, straight, tungsten wire through the grid helix. The grid helix is perhaps 1/16" diameter and is welded every turn to the shell. All this adds up to: good cylindrical diode configuration, close cathode-grid spacing to cut down transit time, and low grid to case inductance. In short, we have a nearly ideal noise diode for a dime a piece.

Construction details: The rf section of the generator is constructed on an aluminum plate bent into an L, the WE 708A protrudes through a 1⅝" round hole to expose its filament pins next to where the UG58A/U connector is mounted on the other side of the L. The WE 708A is held in place by five 8-32 binding-head screws that are tapped into the plate. The UG58A/U has four 200Ω, ½ w resistors soldered to it each at 90° to its neighbors to form a less inductive load, approximating a resistive sheet. These resistors are

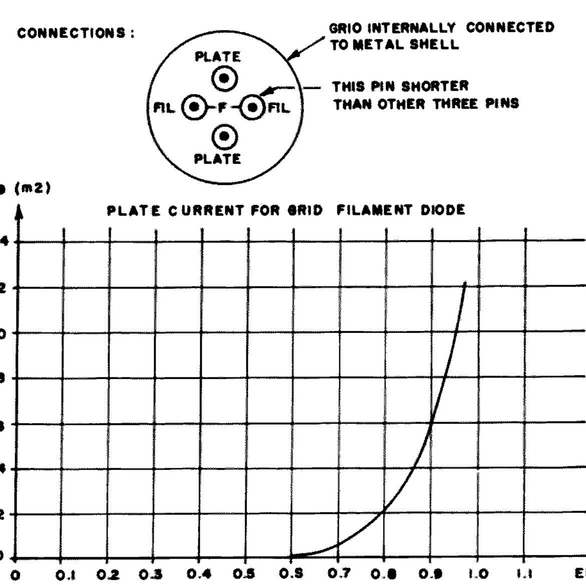


FIG. 3

Fig. 3. Connections of 708A and graph of relationship between "plate" current and filament voltage.

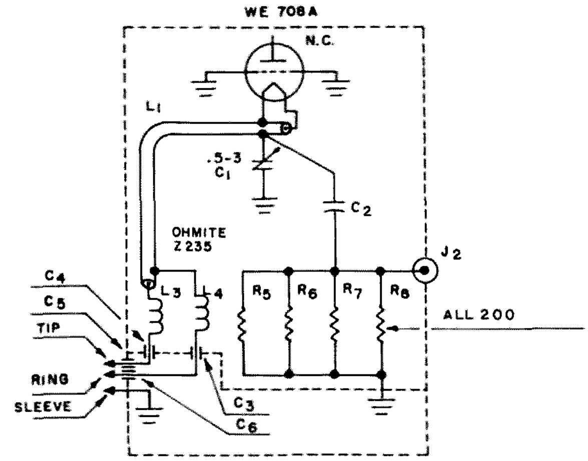


Fig. 4. Circuit of diode noise generator.

soldered to the UG58/U before it is mounted to the aluminum sheet to make soldering easier (less heat required). Then L_1 is formed and soldered from the WE 708A filament pin to C_3. The center filament lead of L_1 is fed through and soldered to the other filament pin and to C_4. C_2 is then soldered in; be sure this is the type called for or a similar low inductance stand-off ceramic. The rest is straight forward. Diode and power supply were each built in an LMB 141 box chassis. The details of wiring the diode circuitry are shown in Fig. 4.

A word about R_1 (the "fine" adjust) is worthwhile. Make *sure* this one is a 2w type A.B. (ohmite) molded carbon pot, if not both R_1 and R_2. This will make smooth diode-plate current adjustment easy; a wire wound pot will cause the plate current to vary in steps because of the effect of the pot's sliding contact sequencially contacting each wire (the same applies if you use a Variac).

To align on 432 mc, C_2 is temporarily removed and a UHF grid dip meter coupled to L_1, loosely. C_1 is adjusted for a dip at 432 mc. Then C_2 is reinstalled, and we should be ready for receiver checks.

The above noise generator was compared with a Hewlett Packard 343A noise diode using my own 432 mc converter as the "to be measured" device. The results showed less than 0.5 db difference.

The author wishes to thank Gene Howell, W4RLU, for his photography of the unit.

. . . W6GXN

Bibliography

1. Jones, F. "V.H.F. For the Radio Amateur," C.Q. Technical Series, p. 178-184.
2. Goodman, B. "How Sensitive Is Your Receiver," Q.S.T., Sept. 1947, p. 13.
3. Geisler, D. T. "Reviewing The Radio Classics," C.Q., June 1963., p. 40.

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The KWS-1 as an SSB Exciter for VHF Heterodyne Converters

Judging by the number of SSB signals now coming up on the VHF frequencies, this is rapidly becoming one of the most popular modes of operation. SSB can do on VHF and UHF what it has done on the lower frequencies: provide more reliable extended range communications. Most transmitting converters marketed are designed for low power exciters, with the higher power ranges requiring attenuation. The KWS-1 is still at the top of the art for high quality SSB, but the high cost of this transmitter has discouraged most experimenters from modifying it.

It is possible to extract the required low level SSB from the KWS-1 on the band of your choice without drilling any holes or soldering internal connections. The attachment may be removed at any time without signs of ever having been present!

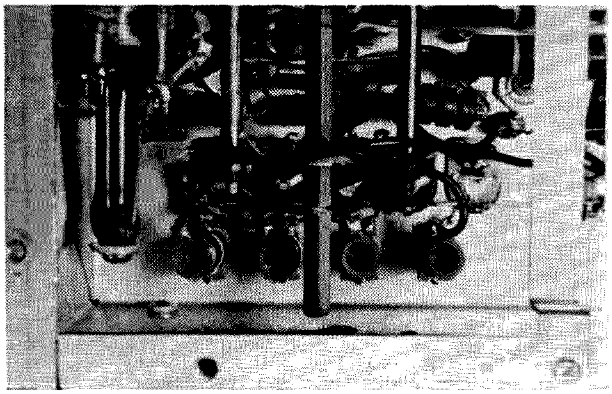
The left rear of the rf cabinet has a large plug button which can be removed. It was placed there should it be necessary to remove the band change switch shaft. Note the "before" photograph where the shaft extends above and between the plate coils of the parallel 6CL6's which are the rf drivers to the final 4CX250B's. This photograph was taken with the bottom pan of the chassis removed. To make room for the coax jack the shaft must be shortened. The shaft is of a non-brittle laminated fibre and saws easily with a hack saw blade. Not much need be removed, about 1½ inches will do. Removing this piece will not interfere with the original purpose of the hole behind it.

The "after" photograph shows the shaft end removed and the coax plug mounted in the shaft removal hole. Either the UG-1094/U or the UG-625/U single hole mount female sockets fit the original hole perfectly. The mating plug for this is the commonly used BNC connector.

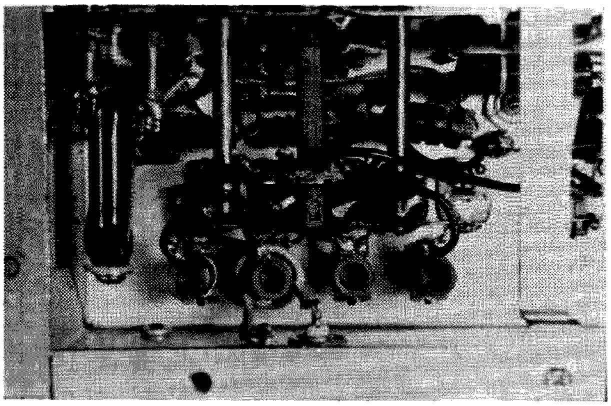
A two turn link is wound around the coil of your choice as shown in the photograph. Some converters call for a 14 mc input, and others for 28 mc. It must be remembered that the direction of wind is the same as the original coil, and that it is placed adjacent to the cold side of the coil which is nearest the chassis pan. The "coldest" end of the link goes to a lug placed under the coax socket nut for a ground and the hot side to the inner conductor of the coax socket.

No retuning of the 6CL6 coils was found necessary, and when this exciter function is desired, the KWS-1 high voltage plate switch is turned off, and 4CX250B filament fuse is removed. When you return to normal HF operation, simply return the fuse and remove the coax plug. That is all there is to it.

. . . W4API



KWS-1 before modification.



KWS-1 after modification.

KWM-1 on LSB

One of the finest values in used equipment on the market today is the KWM-1 selling for about $300 to $350. It is, without a doubt, one of the most rugged, sensitive transceivers ever built. It has a couple of faults, it covers only 10-15 and 20 meter bands, but the sun spot cycle will be bringing back the 10 and 15 meter bands in a couple of years. The other is its inability to operate on lower side-band when the QRM gets tough, this can be easily corrected.

With apologies to Louis Weber, K6GHU, (P. 60 December 1963, 73 MAG), and his excellent article on the KWM-1, I for one always hesitate to actually modify a mfrs. outfit, but Mr. Weber did give me an excellent idea on how to work my KWM-1 on lower side-band without any modifications. First remove the B.F.O. XTAL (the one up front near the P.T.O.) and check its frequency. Next, subtract 455kc from the crystal frequency. Take this remainder from 455kc and you have the frequency of the XTAL you need to get on lower side-band.

As Mr. Weber pointed out, the crystal must be calibrated to .01% as measured into 32 mmfd input capacity. To go on lower side-band, all you have to do is change crystals. I took a piece of Polystyrene rod about 3″ long and ½ inch in diameter and notched each end so the XTAL's just fit into the notches.

With a couple of turns of "scotch" tape to hold the XTAL's in place in their notches, and a small cork on the top XTAL to hold it firmly in place, when the lid is lowered, it's not much of an effort to lift the lid—remove the cork, swap the rod end for end to insert the other crystal, put the cork back on the opposite crystal and close the lid. The dial will tune off frequency about 3kc from where it normally tunes. I obtained my crystal from R. E. Woods Electronics, 2164 North Parkway Drive, El Monte, California.

. . . W3AQY

Ken Morgan KØIEG/6

200 watts with a Swan 240

The Swan Engineering Co. model 240 is a 3 band (3.8-7.2-14.2 mc) transceiver capable of a SSB output of 100 watts pep or more. Adding another 6DQ5 or replacing the 6DQ5's with 6HF5's can double the output.

1. Remove the cover by removing the 3 metal screws on each side of the chassis; remove the screws on the shield plate of the power amplifier cage; remove the back wrap around the shield across the rear of the unit.

2. Remove the 6DQ5 tube and unsolder the red lead to the small capacitor on the PA deck; unsolder the brown-white lead to the meter light above the 0-400 ma meter; unsolder the rf choke that runs from the terminal strip on the chassis to the tube socket; remove the 2 6/32 bolts and nuts that retain the socket.

3. Use a Greenlee 1⅛″ diameter chassis punch to punch the new hole. The hole for the new socket should be up enough to permit insertion of the tube without having to file off part of the base. The punch should be positioned in the hole from which the red lead was removed, as near to the chassis as possible. The female part of the punch should be in the PA cage and the tube socket with the components should be positioned clear of the male part of the punch; use a 7/16″ open end wrench to turn the socket punch bolt.

4. Position the socket in the new hole and use a #27 drill to make the new holes for the socket mounting. *Caution!* Use a smaller size drill to start the hole or the bit may damage the components by drifting off the center punch indentations. Remount the socket and insert the 6DQ5 to check for any errors.

5. Punch a 2nd hole and drill the mounting holes and mount the 2nd (upper) tube socket.

6. Resolder all of the leads and lengthen them as necessary. Check the instruction book schematic and parallel the necessary pins from the lower tube socket to the upper tube socket (except the filament wiring). Connect 20 watt resistor in series with the upper tube filament pins, grounding one side and dressing the lead to the rear of the 12 volt filament supply and the male power plug. Add another braid and plate cap for the upper tube. Replace all the shields, blow out all of the metal crumbs, and check the dress of the added wiring against the pin numbers of the schematic for additional confidence.

7. Connect a power supply of 800/900 vdc @ 400/600 ma. Adjust the bias to the proper level—25 volts. Place a 1% resistor across the meter terminals so the meter reads 400 ma at half scale (200) (Total current is then meter reading times 2). Tune up the xmtr into dummy antenna on the 75 m position, with a Micromatch and Termaline preferred. Check the neutralization as in the book. Adjust the loading as usual except limit the current to 225 ma per tube instead of 275 ma.

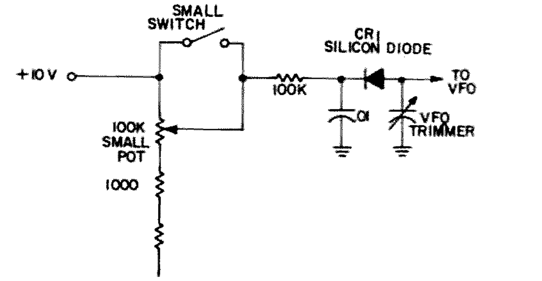
8. Connect an outside antenna and with normal speech your Micromatch should peak to 200 on a short sustained ahhhhh which is a good healthy signal on any man's band. Values of resistances for the filament circuit and meter shunt have purposely been omitted to give the reader a lil' mental exercise.

. . . KØIEG/6

SB-33 on MARS

I imagine there are at least a couple of guys interested in 4.025 mc MARS operation with their SB33's. The modification is simple, easy to do, has only six parts and it does a good job.

The small toggle switch, a Unimax Sub Miniature Snap Acting Switch #1SB-1, is mounted in the upper left hand corner of the front panel just above the dial plate. The silicon diode can be almost any standard type, a 1N456 does a good job.



1. Close S1 adj vfo trim to 4 mc
2. Open S1 set dial to marker past 4 mc
3. Adj pot until 0.025 zeros in on marker past 4 mc

. . . W6PDD

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Cleanliness and a gentle touch are necessities when repairing a meter.

Cartoons by Wayne Pierce K3SUK

Amateur, Spare that Meter . . .

There are probably no pieces of electrical equipment so widely used and so little understood as common D' Arsonal meter. Most amateurs use them continually without very much thought as to how they work, and how to get the most out of them. Wide misconceptions exist about many aspects of meter usage, durability, etc.

Most well-designed units can stand a 1000% overload without suffering mechanical damage, although with ac units, rectifier damage may occur. Meters with target type pointers are, of course, less able to withstand severe overload rapidly applied. The movement upscale has very little likelihood of damaging the target pointer, but the sudden stop at the end of the travel on a suddenly applied overload is quite another thing. The target's mass may bend the pointer.

Mechanical damage by dropping is quite common, and needs no discussion.

Poor location of meters in equipment is something few amateurs consider. The meter's accuracy is entirely dependent on the flux value in its gap. While the meter designer uses material of high stability, demagnetizing can, and does occur. It is customary in a meter factory to make all units about **10%** more sensitive than required. This excess sensitivity is then removed by deliberately "aging" or demagnetizing the flux producing element.

This "aging" stabilizes the magnet and assures reasonable lack of susceptibility to further flux reduction under normal conditions. Close proximity to a strong ac field, such as that produced by a motor or transformer, is not considered as "normal." Slow deterioration may occur with resultant loss in meter sensitivity and calibration error.

The use of a soldering gun in close proximity to the magnet will also cause slight flux loss due to the very high ac field present. With a properly aged magnet this effect is very small.

The life of a meter can be badly shortened, if it is not a sealed unit, by environment. Overly humid storage may cause rusty pivots and resultant friction. Steel particles small enough to be airborne can actually accumulate, over a period of time, enough to cause sticking action.

Rough handling may not cause readily observable meter deterioration. Quite often it appears only in the form of friction. This can be detected by running the meter up scale slowly, stopping, then tapping the meter—the

amount of motion after tapping bring friction error. Rough treatment often causes minute pivot blunting with resultant friction. Friction is always more of a problem with more sensitive meters, as increased sensitivity is usually achieved in a design by increasing the amount of wire involved and the flux of the magnet structure, *and* by reducing the power of the springs. The added wire means more weight, the weaker springs less torque. Result: more friction. The added weight also makes pivots more subject to blunting, so it is necessary to handle high sensitivity meters carefully.

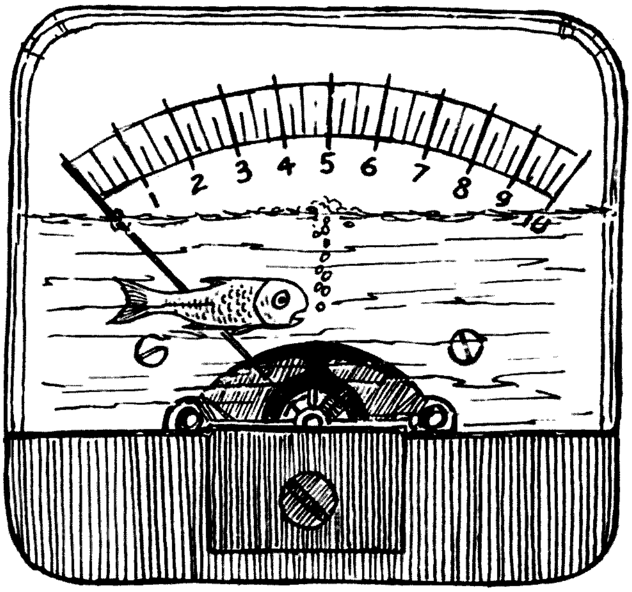
Considerable damage is done to meters by people with the best of intentions. It's bad enough to have overloaded a meter by over 1000%, but the real damage will occur when an attempt is made to straighten out the pointer. Usually such repair jobs come to grief, and there is great wonderment on the part of the amateur abruptly turned meter repairman. Why do meters always go bad when the most capable amateurs try to become repairmen?

The first disaster which will befall a meter with a bent pointer, occurs when the amateur sits down at his desk and takes the front off the meter. Unless a sheet of clean white paper was placed on the desk top prior to opening the meter, every tiny speck of steel trash in the area will jump at once into the meter. One almost invisible speck on the core will cause the meter to become "sticky."

So the meter that originally had only a bent pointer, now has an added built-in complication—a tendency towards stickiness.

If our friend did put a sheet of clean paper down, he probably forgot to demagnetize and wipe off all the steel chips from the needle nose pliers he's using.

If the meter survives thus far, the innate curiosity disease will surely set in. The first symptom of this is the observation, "Say, look at how they do this in this meter." It is natural to touch the point involved while making the observation. Such touching usually ignores the presence of the hair spring, and it gets bent. This seems to be no problem since in about



An overly humid atmosphere may cause deterioration of the meter . . .

half an hour we have it all straightened out, "as good as new," except we now have wrecked the linearity of the meter, as well as its calibration at end scale.

Oh yes, that pointer! With great aplomb it is straightened out. Of course, the meter is now off poise or balance, and won't read the same horizontal and vertical. This fault is usually not observed at first, although some fellows may wonder why the meter makers put those "silly springs" on the pointer base.

Just before the meter front gets put on for the last time, our friend will discover the little screw which adjusts the jewel. The usual reaction to this is to tighten it up just a "hair." The pointer won't wobble so much that way. Indeed, it will hardly move at all, due to the blunted pivot or pierced jewel caused by our repairman.

The front will go on for the last time now. Actually, it'll go on and off several times, since the zero adjuster usually will miss the slot. About this time it's discovered quite often that the meter won't go to zero. Remember the spring trouble and the poise?

A few minutes and cuss words later, our amateur places the meter at arm's length and admires his work.

. . . W8BPY

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Transistor RF Power Amplifier Design

The amateur will find solid state circuitry desirable in many transmitter applications such as oscillators, frequency multipliers and power amplifiers. Though there are similarities in tube and semiconductor circuit design, there are also very important inherent differences between transistors and vacuum tubes which must be taken into account in circuit design. Unlike vacuum tubes with high input and output impedance, the transistor is a low impedance device. The input impedance, which is dependent on frequency, may be as low as ten ohms. Collector output impedances in the fifty to one hundred-ohm range are often encountered.

Transistor circuits require crystal controlled oscillators for maximum frequency stability. Since the output frequency is often much higher than the oscillator frequency, several stages of frequency multiplication may be required.

The number of amplification stages required to obtain a specified output power is a function of the power gain of the transistor. The gain in turn is a function of frequency, supply voltage, circuit configuration, class of operation and drive power.

Operation of low level stages in class B or C is inefficient and results in low power gain since drive power is necessary to turn the device "on." Therefore low level stages can be operated in class AB. However, for high drive level, class C operation is preferred because of the high efficiencies which can be obtained.

The goals to achieve in class C amplifier design are high dc efficiency, large power output and low drive power. As is generally the case, some compromise is required to attain these goals.

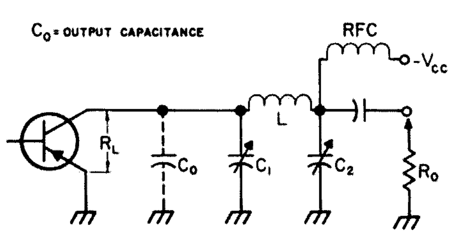
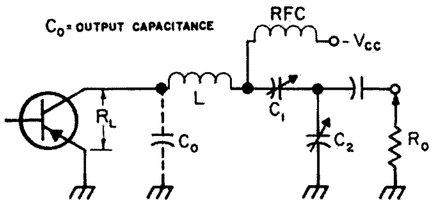


Fig. 1

Both common emitter and common base circuits are used for rf power amplifier designs. The choice is influenced primarily by operating frequency, power gain and desired bandwidth.

Fig.2A



Tank Circuit Design

The amplifier's output tank circuit must supply a proper load impedance and must not consume too much of the amplifier's power. At the same time the output tank circuit efficiency should be high.

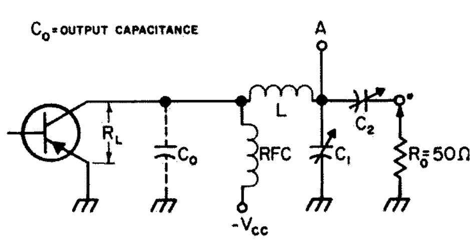
Usually the dc supply voltage is known in addition to the desired power output. The load impedance that the collector will see may then be calculated from equation (1) (neglecting $V_{CE\,sat}$).

$$R_L = \frac{(V_{CC})^2}{2 . P_O} \qquad (1)$$

V_{CC} = collector supply voltage.
P_O = power output in watts.

Fig. 1 is a schematic of the familiar Pi network. The formulas for calculating the reactiv components C_1, C_2 L and the value of R_L are as follows, assuming V_{CC} = 15v, P_O = 0.5 watts, and Q_L (loaded Q) = 5, R_O = 50 ohms:

Fig. 3



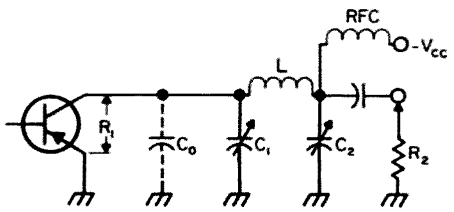


Fig. 4A

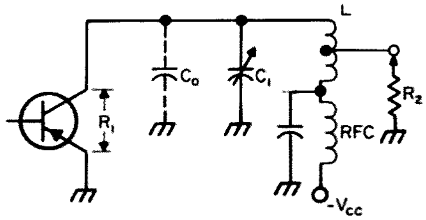


Fig. 4B

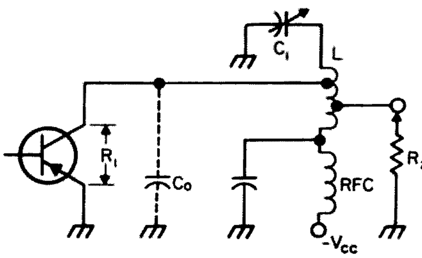


Fig. 4C

1. $R_L = \dfrac{V_{CC}^2}{2\ P_O} = \dfrac{(15)^2}{2 \times 0.5} = 225$ ohms

2. $X_{C_1} = \dfrac{Q_L}{R_L} = \dfrac{225}{5} = 45$ ohms

3. $X_L = X_{C_1} = 45$ ohms

4. $X_{C_2} = R_O \sqrt{\dfrac{R_L}{R_O\ (Q^2+1) - R_L}}$

$= 50\sqrt{\dfrac{225}{50(5^2+1) - 225}} = 23$ ohms

The output capacitance, C_O, can be a problem when designing matching networks for use at two meters or higher. The capacitance C_O is an appreciable part of C_1 when compared to the calculated value of C_1. Since C_1 and C_O are essentially in parallel they will add, and a value of C larger than C_1 calculated will have to be accounted for, and may then make the Pi network as shown in Fig. 1 impractical. Fig. 2, however, shows as alternate connection for the Pi network. The combination of L and C_1 is now a variable inductor which is tuned to resonate with C_O at the operating frequency.

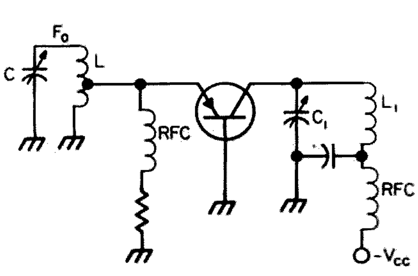


Fig. 5

The values of the reactive components are calculated as indicated for Fig. 1.

The Pi network is desirable in applications in which feed-through of subharmonics is of no consequence. In many cases, however, in which the operating Q of the matching network is very low the T network shown in Fig. 3 will better meet the needs of the problem. In such a circuit, the loaded Q is increased by raising point "A" to an impedance level of 1 k ohm (or more) and then transforming down to the 50 ohm output impedance. Tuning to resonance is accomplished by means of C_1; loading is accomplished by means of C_2.

Assuming $Q_L = 5$, $R_L = 75$ ohms and R_O is the output load, the values of the components of the T network can be calculated in following manner:

1. $R = R_L(Q_L^2 + 1) = (50)(5^2 + 1) =$ 1300 ohms

2. $X_1 = \dfrac{R}{Q_1} = \dfrac{R}{Q_L} = \dfrac{1300}{5} = 260$ ohms

3. $Q_2 = \sqrt{\dfrac{R}{R_L}} = \sqrt{\dfrac{1300}{75}} = 4.2$

4. $X_2 = \dfrac{R}{Q_2} = \dfrac{1300}{4.2} = 310$ ohms

5. $X_L = Q_2 R_L = 4.2(75) = 315$ ohms

6. $X_{C_2} = \dfrac{R_O}{Q_1} = \dfrac{50}{5} = 10$ ohms

7. $X_{C_1} = \dfrac{X_1 \cdot X_2}{X_1 + X_2} = \dfrac{260(310)}{260 + 310} = 140$ ohms

Interstage Couplings

The input network of the following amplifier must provide coupling between the driving source and the base to emitter circuit. In most applications, the load impedance of the driving stage is much higher than the input impedance of the amplifier. The input impedance must therefore be "transformed up" to the correct load impedance value for the collector circuit of the driver stage. Several circuits which will provide matching between the collector and

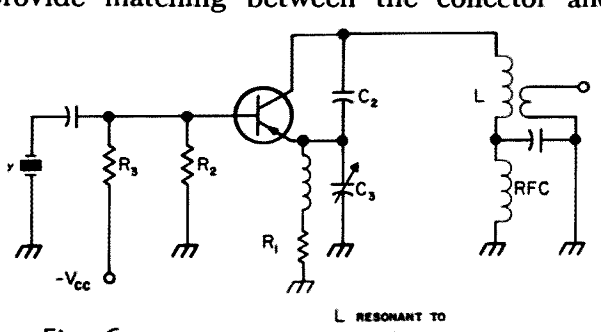


Fig. 6

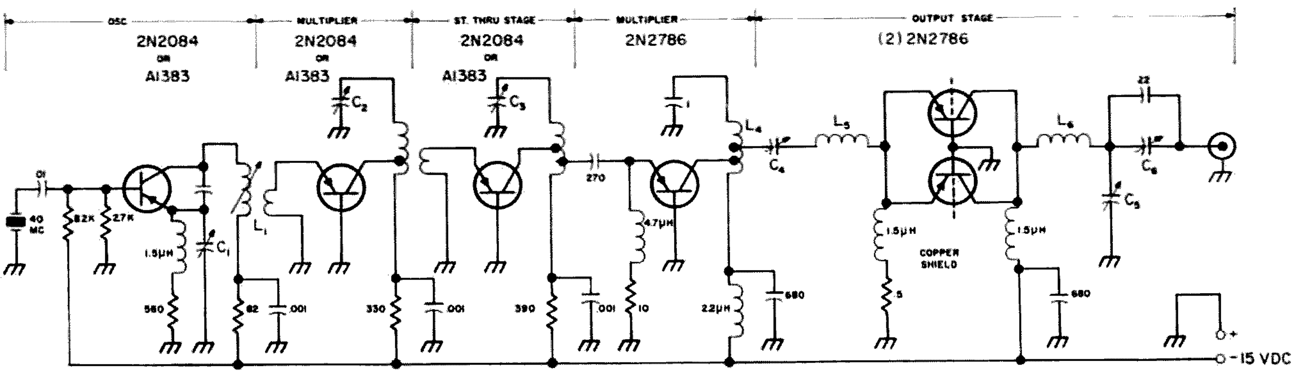


Fig. 7

L1, 7T #20E 1/4" dia. close wound, 2T link #24 insulated at cold end
L2, 6T #18 bus bar, 5/16" dia. 1/2" long, tap 3T from ground link, 2T #24 Ins.
L3, 6T #18 bus bar, 5/16" dia. 1/2" long, collector tap 3 turns, base 1 turn, both taps from cold end of coil
L4, 2 1/2T #14, bus bar 7/16" dia. 3/8" long
L5, 6, 2T #14, bus bar 1/4" dia. 1/4" long

C1, 6, 7-100 pf
C2, 3, 5, 4-25 pf
C4, 2-12 pf
All variable capacitors are compression type. Air dielectric type capacitors can be substituted if desired.
Heat sink for the three 2N2786's Wakefield Engr. #207.

the base-emitter circuit of the following stage are shown in Fig. 4.

Fig. 4A is a Pi network while Figs. 4B and 4C are ordinary parallel resonant tank circuits. In Fig. 4C a tap point is provided for the collector circuit. This point is best determined experimentally. It should be noted that parallel tuned circuits provide the best suppression of subharmonics.

In Fig. 4, R_1 is the collector load impedance, R_2 is the input of the next stage and Q_L is the operating Q. The values for the reactive components of Fig. 4A can be obtained by use of the following relationships:

$$1.\ X_C = \frac{R_1}{Q_L}$$

$$2.\ X_{C_2} = \frac{R_2}{\sqrt{\frac{R_2}{R_1}(Q^2+1)-1}}$$

$$3.\ X_L \approx X_{C_1}$$

Frequency Multipliers

A frequency multiplier stage is operated as a class C amplifier. The power efficiency for a multiplier (as is the case for any class C amplifier) is a function of the conduction angle of the individual stage, the peak collector current, I_M, and the collector voltage V_{CC}. A typical frequency multiplier stage is shown in Fig. 5. Note that the values of C_1 and L_1 are selected to resonate at two or three times the value of f_o.

Crystal Oscillator

The power amplifier and multiplier stages have been discussed and all that remains is to provide an rf signal to drive the other stages. A typical crystal oscillator is shown in Fig. 6.

The oscillator is a common base, modified Colpitts type, with the crystal used in a series mode. R_1, R_2 and R_3 provide the transistor biasing, and the feedback is determined by the ratio of C_2 to C_3. The values of C_2 and C_3 also depend upon the power output and frequency stability desired. Frequency stability is further assured by using a small collector current swing and loose coupling between the oscillator and multiplier circuits. The loose coupling will insure that loading effects of the multiplier on the oscillator are negligible.

Conclusion

The various stages discussed in the previous paragraphs have been treated in a somewhat general manner since individual requirements such as components, frequency, etc. must be considered.

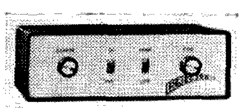
Fig. 7 is an overall schematic of a complete CW transmitter in which the various stages have been combined. It should be noted that this design is only representative of how the final result would appear. The values for the capacitors and coil data given are for 160 mc. Most adjustments will hit 2 meters without much trouble.

The output stage is composed of two class C amplifiers connected in parallel. They are slightly back biased by the 0.5 ohm resistor in the emitter circuit. C_4 and L_5 is a series tuned circuit, resonant at the frequency of the second multiplier.

The output network L_6, C_5 and the parallel combination forming C_6 is a T matching network which is designed to reject subharmonics and higher harmonics of the desired frequency.

. . . WA2DJU

New Products



Galaxy Rejector Notch Filter

Galaxy Electronics has introduced the Rejector, a tunable notch filter. This seven transistor notch filter greatly improves the reception on any ham receiver or transceiver. The Rejector is tunable from 300 to 5000 cycles to suppress heterodynes, QRM, ignition noise, background noise and other irritating receiver interference by over 40 db. It connects between the receiver output and speaker. The front panel is reversible for either horizontal or vertical mounting. It's only 7½ x 5⅜ x 2½. Price: $34.95. You can get more information from Galaxy, 10 South 34th St., Council Bluffs, Iowa.

New Amperex SSB Tube

By now, most hams know that there is more to a sideband amplifier than its power output. Amperex' new 8579 beam tetrode is designed to give excellent linearity in SSB service up to 60 mc. A special geometry has been used to keep third order distortion products better than 30 db down. The 8579 can supply 110 watts PEP in AB_1 SSB CCS service. In class C, it gives 110 watts output with only 600 volts on the plate. AM rating is 94 watts and it also makes a fine modulator. The tube is highly efficient and its low drive requirements simplify driver design. The 8579 has double ended construction, a common basing arrangement and a hard glass envelope. Price is $21.50. Amperex at Hicksville, N. Y. can give more information and data sheets.

L. F. Kiner K6VNT
1213 Pacific St.
Santa Monica, Cal.

Some Worthwhile Seneca Modifications

Having owned and operated a Heath Seneca for the past two years the author has made numerous modifications to the original unit that have proved rewarding and worthwhile.

For those Seneca owners who may wish to incorporate part or all of these modifications, the following pages will explain how it is done.

Audio Stage Improvements

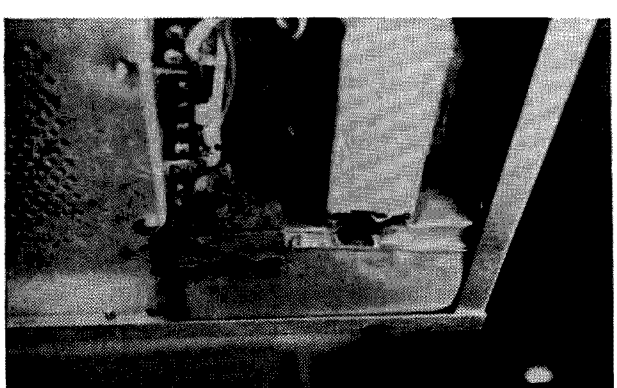
To preclude the possibility of rf getting into the audio section of the Seneca, add an rf choke in series with the .001 mmfd input capacitor, C28. If you intend to operate primarily on two meters, use an Ohmite Z-144, otherwise a Z-50 should be used.

To reduce hum and incorporate additional B+ filtering two components are added. Refer to pictorial 14 on page 38 of the Seneca manual. The following steps are taken:

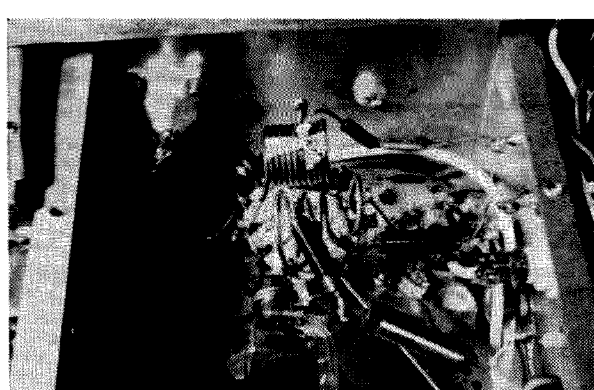
1. On terminal strip AA remove the orange jumper between terminals two and four.
2. Replace the orange jumper with a 2-watt 15K or 20K resistor. Solder the connections at terminal four (there will still be three wires on this terminal).
3. Solder a 10 to 15 mfd/450 w vdc—smallest size possible—electrolytic capacitor to terminal two (again, there will be three wires). The negative (-) side of the capacitor is soldered to the most convenient ground point available.

This added filtering and decoupling will reduce existing hum and perhaps some improvement in the audio quality will also be noticed.

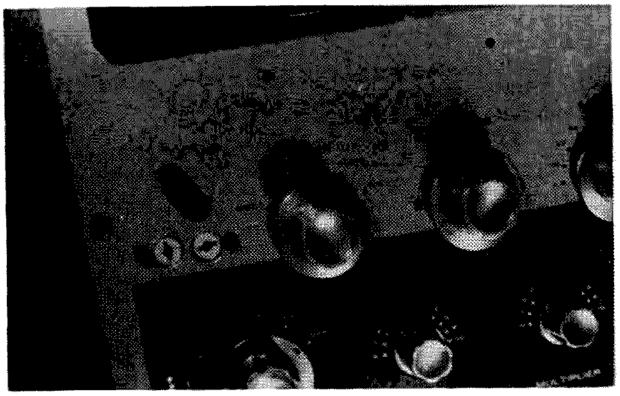
Before making the above additions to the



Copper shield around audio stage is shown soldered in place. Note that shield is soldered directly to the choke case.



Note lacing cord tied around grid coil L9 compressing the coil for maximum grid current.



The front panel crystal socket is mounted directly below the power on pilot lamp and to the left of the meter switch.

audio stage of the Seneca it may be necessary to remove the parallel 6.8K resistor and 2 mmfd capacitor. If you do, don't forget to replace them.

Whatever hum may remain will undoubtedly be removed by the following:

The low voltage filter choke is located next to the audio section and is isolated by cutting some copper sheet stock and completely enclosing the audio section as shown in the photo.

Referring to pictorial 18 on page 52 of the Seneca manual, it can readily be seen that the choke, 46-22, is a most likely suspect in the cause of hum. Be sure that your shield is on the audio section side of the choke and that it does not short out any components.

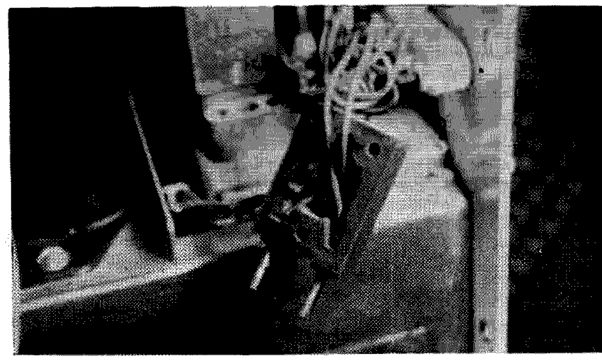
Solder the shield directly to the top of the filter choke and at two or three places on the chassis that are convenient. The shield will be mostly self-supporting if cut a little oversized and forced into position. The shield is quite effective in eliminating hum introduced by the filter choke.

Lack of Grid Drive?

A number of Seneca owners have complained of a lack of grid drive. Adjusting coils L7, L8 and L9 according to the manual instructions may help but in too many cases it seems that coil L9 wants to be compressed beyond its capability.

This was the case with the author and several other local Seneca owners. The solution?

Take a short length—about 12 inches—of nylon lacing cord and tie the coil into the desired compressed position. This is done with the B+ off of course. A little experimenting here with the lacing cord position and tension will disclose the optimum condition which will deliver grid current plus. Of course you should first check the 2E26 to be sure your lack of grid drive is not just a flat or mushy tube.



"Dummy" FT-243 crystal holder with cover removed to accomodate new leads.

Adding a Front Panel Crystal Socket

Probably the most inconvenient feature of the Seneca is that of changing crystals. Although this can be done through the top access cover—(we've done it, but don't recommend it)—it certainly leaves much to be desired and may cause many gray hairs to sprout. Crystals may also be replaced by removing the chassis itself. Remove the front panel screws and the rear apron screws and slide the unit out of the case to make the crystal sockets accessible.

A simpler and more desirable feature would be to have a crystal socket on the front panel. Why not? This inolves only about 30 minutes of labor to mount the crystal socket.

The best position for the crystal socket is directly below the power on light.

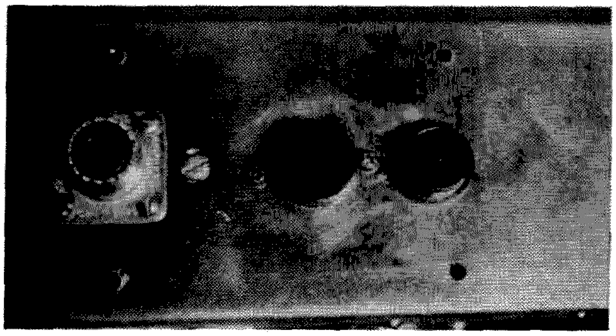
Make yourself a template of the crystal socket you intend to use and gently center punch the points to be drilled. Center punching is almost a necessity to avoid the drill skidding and marring the panel. *Before drilling*, be sure the area directly behind the proposed crystal socket is clear or you may find yourself rewiring the meter switch harness.

After the panel has been drilled and the socket mounted, it will be necessary to make the connections to the front panel crystal socket.

This can be done by wiring directly to the XTAL-VFO selector switch, or a "dummy" crystal may be inserted into one of the original crystal sockets and leads brought up and soldered to the new crystal socket. This is made by removing the crystal cover and insides from an FT-243 crystal holder. Solder new leads to the pins of the FT-243 "dummy" of sufficient length to reach the added crystal socket and solder.

Going to Plate Modulate?

The merits of plate modulation versus controlled carrier modulation have been written about many times so we'll bypass that for



Connector for modulator is mounted between the mike connector and coaxial connector.

now. If you want to plate modulate the Seneca it will be necessary to do the following:

1. Break the plate B+ connection to the 6146's and insert the modulator leads.

2. Replace feed-through capacitor FT-15 with a unit of higher voltage rating—preferably 3KV. The original 1KV unit just won't stand the gaff when plate modulating. This can be done easily by installing one of the standard ceramic feed throughs and by-passing with a .001 mmfd 3 KV capacitor.

3. Installation of a two-pin connector on the rear apron of the Seneca chassis to accept a mating plug from the modulator. The author installed this connector between the mike connector and coaxial connector.

4. Disable the existing Seneca audio. This is best done by simply removing the 12AX7 and 6DE7 from their respective sockets.

After you have installed the modulator connector, refer to pictorial 18 of page 52 of the Seneca manual.

1. Remove the orange lead between terminal 4 of terminal strip DD and terminal 1 of terminal strip BB.

2. Connect a lead from terminal 4 of terminal strip DD to one of the pins of the modulator connector and solder. (This will be the connection to the low side of the modulation transformer secondary).

3. Connect another lead from terminal 1 of terminal strip BB to the other pin of the modulator connector and solder. (This will be the connection to the high side of the modulation transformer secondary).

Be sure to use good quality high-voltage wire. The type used by the author is test lead cable. This is very good and has a breakdown of 10KV or better.

With this done the modulator may be connected to the Seneca by using a mating plug. Polarized plug and connector are recommended to insure that correct connections are made at all times.

If you decide that you want to revert to controlled carrier operation, put the 12AX7 and 6DE7 back and insert a "shorted" plug into the modulator connector.

Fig. 1 shows the schematic result after adding the modulator connector.

In conclusion, I would like to say that I have made all of the foregoing modifications and am most pleased with the results. There has been a minimum of alterations to the original unit and the re-sale price—(if you ever think of selling the Seneca)—should be maintained if not improved.

Our thanks to Sal, WA6PMP, for his suggestions on improving the audio section and the reduction of hum. 73.

. . . K6VNT

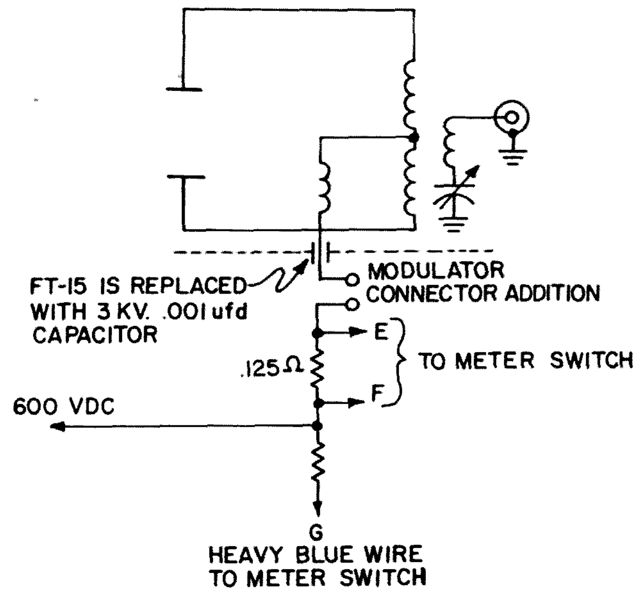
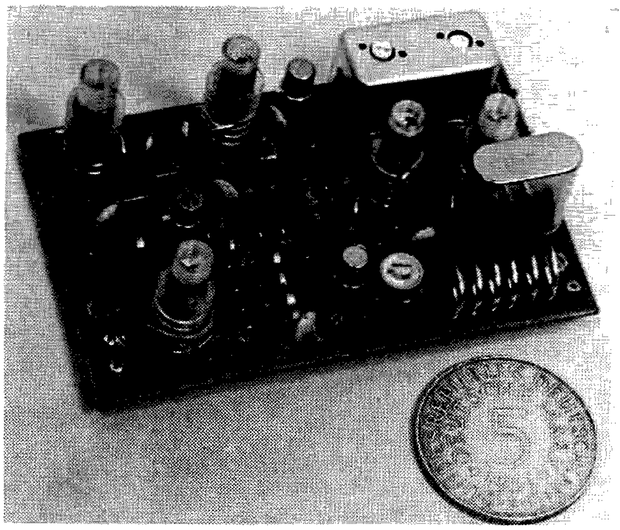


FIG. 1

Fig. 1: Schematic diagram showing modulator connector inserted in 6146 B + line.

Original feed thru capacitor is replaced with ceramic feed through and 3KV .001 mmfd capacitor.

Ulrich L. Rohde
Technical Consultant
German Amateur Radio
Club (DARC)



A Low Noise Transistorized 2 Meter Converter

The electrical performance of modern vhf transistors and their low price now encourage many hams to use them for a number of applications—especially in vhf converter circuitry for 2 meters.

The information given here covers some of the important details of a German 2 meter converter, fully transistorized that has a noise figure of less than 2 db.

This converter compared with one using the famous 417A tube proved to have not only a lower noise figure but also the ability to handle high input signals with amazing linearity.

Glancing at **Fig.** 1, one can see that the input circuit has a transistor with a series resonance circuit between base and emitter and this is "grounded" by a capacitive voltage divider. Since the emitter configuration requires neutralization, the base configuration has lower amplification but the compromise is a good one. This compromise provides better noise attenuation and better impedance matching. Furthermore, the combination affords a means for feed-back compensation and allows stable operation.

The diode shown connected to the base of the AF-139 transistor is used to provide a distortionless signal to the mixer; but its main purpose of course is to reduce cross-modulation generated mixer products.

A high Q bandpass coupling circuit is used between the rf amplifier and the mixer. The bandwidth of this circuit is ± 1 mc. Measured image rejection is greater than 50 db.

Additive mixing is used applying 170 mv of rf signal from the oscillator to the base of the mixer transistor. For distortion free operation high emitter current is used on the mixer.

The output bandpass filter in the mixer output at 29 mc has a bandwidth of $\pm$ 3 db.

In designing the converter, the most difficult problem encountered was the design of the 116 mc oscillator. In order for it to operate properly the frequency accuracy had to be within $\pm$ 15 cps in the temperature region $\pm 5°$C (41°F) and 50°C (122°F). The average production tolerance could not exceed 100 cps and this could only be achieved by a very expensive crystal made especially for the set in Germany by a firm which only

BATTERY*	R1	R2	R3
6 VOLTS	4.3K	3.9K	3.9K
9 VOLTS	8.2K	6.8K	6.8K
12 VOLTS	12K	10K	10K

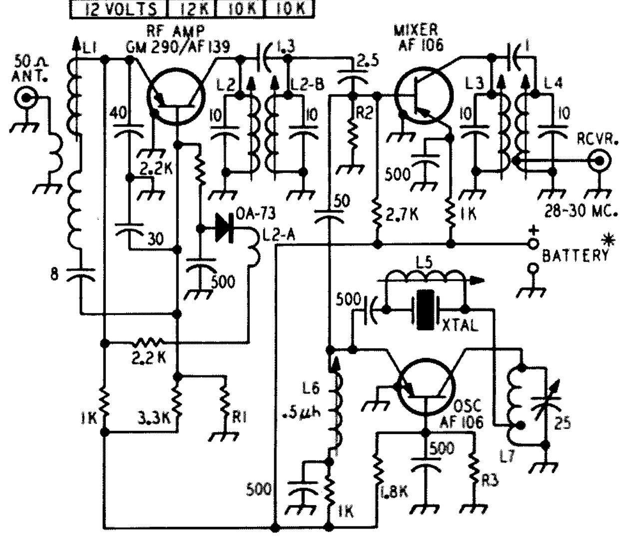


Fig. 1. Two meter converter.

produces frequency standards equipment. The crystal used operates at the 5th overtone and produces *no* spurious signals.

The ultra low noise figure (better than 2 db) was achieved by using a special Texas Instruments transistor type GM-290 (uhf-tv-type). Better attenuation of cross modulation and better signal handling capability can be obtained by using the Fairchild IW-8343 (uhf-silicon) epitaxial-planar type. Amperex A1220 is another equivalent.

The mixer and oscillator transistors are not critical but should have an f_T higher than 250 mc. Amperex 2N2495 or 2N2496 are direct equivalents.

The size of the converter is very small, only 2" × 3⅛" and weights only 46 grams. A glance at the photo of the converter with the 5 mark piece (about the size of the American half dollar) shows the neat layout of all parts on the printed circuit board.

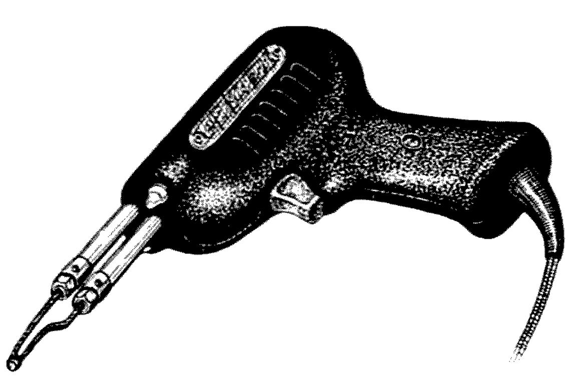
The coils L-1 through L-6 are special units. No data is given here on the coils for competitive reasons. You'll have to dip them if you want to build the converter.

Fig. 2 shows that R-1, R-2 and R-3 should be changed for optimum operation when using different battery voltages. The resistors in question are circled on the diagram.

The overall characteristics of this converter are: frequency range 144-146 mc, oscillator frequency 116 mc, image rejection better than 50 db, spurious signals *none*, *if* (receiver) 28 to 30 mc, noise figure 1.7 KT_0, power gain 25 db, input voltages 6, 9 or 12 volts and current 7 milliamperes.

The retail price in Germany of the unit is 32 U.S. dollars and can be obtained from the factory, K. H. Lausen, Funktechnishe Erzeugnisse, 32 Hildesheim, Bahrfelderstr 11, West Germany. A distributor for the unit in the U.S. is being selected.

. . . Rohde



. . . K3SUK

Letters

Dear Wayne:

I was intrigued by your article on page 52 of March "73" Magazine. Mr. Ackerson did a nice presentation but it won't work since the ten diodes in half of the bridge will blow on the first half cycle. The bottom diodes are all reversed. Apparently Mr. Ackerson thinks along the same lines we do since even the case, method of mounting the 100 mfd capacitors and parts list are strangely similar to our old Model 250-AC and later 350-AC.

Best regards,
Bernard J. Bisnett, President
Linear Systems, Inc.

Dear Wayne:

I noticed that the price of QST has been raised to 60 cents. I stopped subscribing to their magazine over 4 years ago. One reason for this was that their circuits were so elaborate it would be cheaper to buy commercial gear than to homebrew.

I have successfully built several pieces of gear from your magazine, including a SSB transmitter which is doing a fine job and has since last August. Please keep your magazine practical so that the average ham can build equipment from it.

Your price only went up 3 cents in a great number of years . . . A fine magazine . . . keep up the good work.

Samuel Armstrong WA2JVE

And we went up from 37c to 40c mainly because of the coin shortage which made giving 13c change a lot more difficult than a dime.

Dear Wayne:

Just received the Feb. issue. It is really great. I especially concur with your comments on the stamp. It is almost an insult. I couldn't believe my eyes when I first saw the thing.

Keep up the good work with 73. It is really different to find a good ham magazine in the mailbox with QST.

Charles R. Cox, K8TUO/AREA
Athens, Ohio

Dear Sir,

I am one of your readers and I am enclosing herewith a snap of my SSB generator which gives 50 watts output on 14, 21 & 28 Mc band using Collins mechanical filter and 7360 as balanced modulator. Results are just wonderful. This is an 1965 edition from VU2CQ. I do have two other side band generators, one phasing type and another high frequency filter type.

"Mickey" Mozoomder VU2CQ
Bombay, India

Dear Wayne;

I am certainly not trying to tell you how to run your business but that thing of "Big Brother" re advertising in the current issue makes me mad. Why don't you ask your readers to always mention "73" when ordering equipment?

I have just ordered a VENUS and told them it was because of the write-up in the Dec. "73." I also ordered a "22'er" and told them it was because of the write-up in the current issue of "73."

I ALWAYS say it was because of "73" whenever I write or order—(even if I saw it in "QST"!!!)

Keep up the good work!

Wilmer W5VV
Austin, Texas

Dear Wayne,

Keep up the good work and the fine articles in 73. I want to belatedly thank you for the restoration of the propagation condition forecasts. And for your information, an **official** first day cover for a stamp is available to anyone merely by sending the amount of the stamp and a self-addressed envelope to the postmaster in the city of issue. If one wants a cacheted envelope there are many commercial firms that supply them for all commemoratives issued. The ARRL statement that "official first-day covers are available **only** from the League" (italics theirs) is a lie. I would like to know how much they made on that little deal and if they really thought no stamp collectors were hams.

William Farone W5NOK
El Paso, Texas

Dear Mr. Green:

I am an avid follower of your magazine in the Charlotte area, and I would like to say it far surpasses the other same publications in this field. The content is quite informative for the "learning" amateur and complex enough for the old "pro." Even your advertisements prove very interesting. I would like to thank you for this from the Charlotte hams.

Ted F. Goldthorpe, Jr., WA4VCC

Dear Wayne,

I have one gripe. As soon as I open your magazine and I see a hastily thrown together rig using a 2C39 and globs of solder I figure K1CLL has been at work. In general it tends to degrade your otherwise excellent magazine and the overall picture of VHF-UHF construction.

Ken Decker WA6OSB
San Diego, California

Being contrarywise by nature I say a minimum of three huzzaws for Bill and his scissors and solder UHF construction techniques. Sure, I love the look of that beautifully machined brass equipment, but I know that if that is the only thing I publish we are not going to have many fellows on the UHF bands. Bill has shown that anyone can build UHF gear that works well and do it on the kitchen table.

Dear Mr. Green,

You have often spoken well of the Swampscott Convention in your magazine. I have been to the Hudson Division Convention and was very disappointed. I am thinking of driving up from New York if it is worth the trip. What organization do I get in touch with beforehand?

Bert Lane W2HBQ
Wantaugh, New York

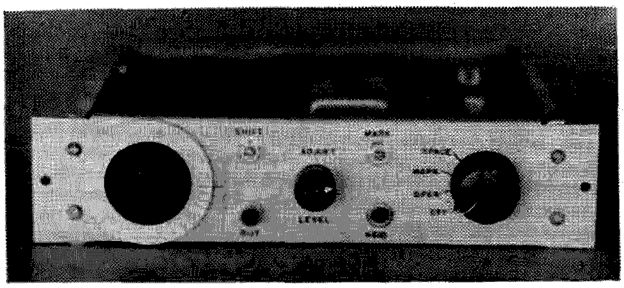
For Heaven's sakes don't miss the biggest convention of them all at Swampscott's New Ocean House April 24-25th. I'll be on the speaker's program and have a big booth there to say hello. Write to Eli Nannis W1HKG, 37 Lowell Street, Malden, Massachusetts for further info and be sure to come on up with the family.

Gentlemen:

K4NMV, 1736 28th Street, Ensley, Birmingham, Alabama has available at no charge copies of a callbook of amateurs belonging to the Church of Christ. Please send a #8 stamped self addressed envelope.

K4NMV

More letters on p. 82.



Tom Lamb K8ERV
1066 Larchwood Rd.
Mansfield, Ohio

A Novel AFSK Oscillator

Let's see, this morning I'll build an audio shift oscillator for the expected model 15, and this afternoon I'll . . . As with most projects, building a good AFSK oscillator turned out to be more than a one-morning job.

The standard capacity-switched L-C oscillator left much to be desired. Switching a discharged condenser into an oscillating circuit causes a pause in the oscillation, resulting in a shortened *mark* pulse. Switching transients above the normal output level were seen, which can cause overmodulation or require operation at reduced modulation levels. The switched-C oscillator does not normally have equal *mark* and *space* output levels, and cannot easily be adjusted to exact frequency. It does have the advantages of simplicity and excellent stability.

Next I tried a Clapp vfo, using a three-gang variable condenser to permit variable shift and easy adjustment. The switching transients still existed and the *mark-space* output varied widely.

If the added *mark* capacity were very small compared to the normal circuit capacity, the oscillator circuit Q and impedances would be nearly constant and there would be no switching problem. A large shift can be obtained from a very small added capacity only if the operating frequency is high, as in a beat-frequency audio oscillator (remember them?). Such a shift bfo was tried and produced an excellent switched waveform having easily adjustable shifts. Unfortunately even a carefully designed transistor bfo has very poor long term drift problems that make it unsuitable for RTTY work.

But cheer up, don't throw away your printers (unless you throw them my way), things are getting better! There is one type of oscillator admirably suited to AFSK service, but apparently never used. It has good stability, constant output, shifts instantly and without transients, and is quite easy to shift and adjust—the lowly relaxation oscillator!

Look at the characteristics of two relaxation circuits, Fig. 1. The neon bulb is probably the more familiar, but the unijunction is more stable and will be used in the oscillator. The output amplitude is determined by the device characteristics, not by the frequency-determining R and C. The frequency is easily and smoothly shifted if the charging resistance R is changed. The sawtooth output is easily smoothed into a sine wave by a low-pass filter.

Fig. 2 shows the circuit of an AFSK relaxation oscillator. The unijunction transistor is an inexpensive and stable solid-state equivalent of the neon bulb. Its operation is thoroughly covered in the *General Electric Transistor Manual* and will be described only briefly here.

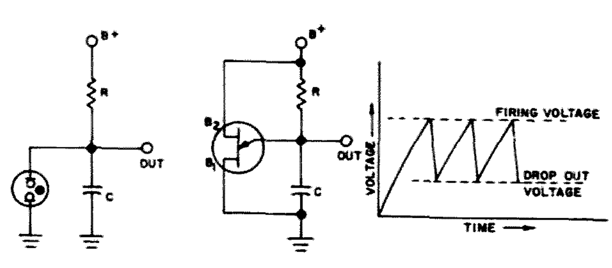


FIG. 1 RELAXATION OSCILLATORS

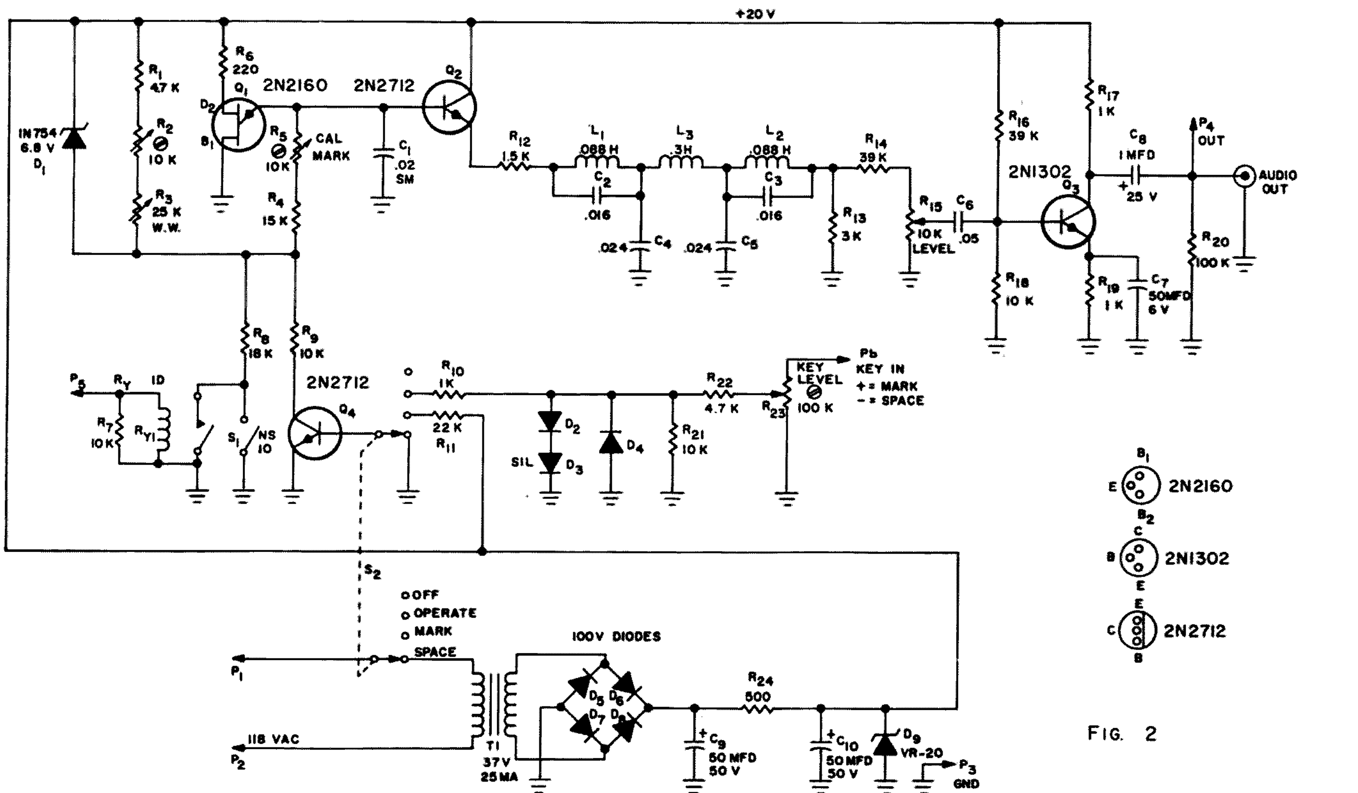


Fig. 2. The novel AFSK oscillator. Connect bottom 3 terminals of bottom section of S_2 so that the oscillator will be on in operate, mark & space.

Operation

The unijunction is operated with + 20 volts on base two. The emitter is an open circuit for voltages below about 10 (varies with the transistor). As condenser C_1 charges through resistors R_1 through R_5, its voltage builds up to 10 v. At this voltage, the emitter to base-one junction breaks down, much as the gas in a neon bulb, and discharges C_1. This cycle repeats, producing the familiar sawtooth voltage across C_1. If the charging resistance is returned to the same voltage point as base two, the relaxation frequency is remarkably independent of voltage and temperature variations.

The generated sawtooth voltage is isolated by emitter-follower Q_2 and fed into a low-pass filter. As seen in Fig. 3, the filter cuts off above the *space* frequency (2975 cps) and is almost 40 db down for all harmonics of both the *mark* and *space* frequencies. The output waveform is a very good sine. The input resistor, R_{12}, can be set so that the output voltage varies less than ½ db over the range of 2125-2975 cps.

Inductors L_1 and L_2 are the familiar telephone loading toroids. L_3 is a toroid removed from a surplus filter. Condensers C_2-C_5 should be low loss units such as mica or polystyrene, selected for proper value on a bridge.

After filtering, the tones are amplified by Q_3. R_{14} is set to prevent overloading of Q_3 at maximum level.

Keying is accomplished by saturating (mark) or cutting off (space) transistor Q_4. With Q_4 cut off, Q_1 oscillates at a *space* frequency determined by the sum of R_1 through R_5. Diode D_1 does not conduct. With Q_4 saturated, R_9 causes D_1 to conduct at a constant 6.8 volts regardless of the setting of the shift pot R_3, and Q_1 now oscillates at a *mark* frequently determined only by R_4 plus R_5. The shift is adjustable from 100 cps minimum to 850 cps maximum by rotating a potentiometer, but the *mark* frequency is held at 2125

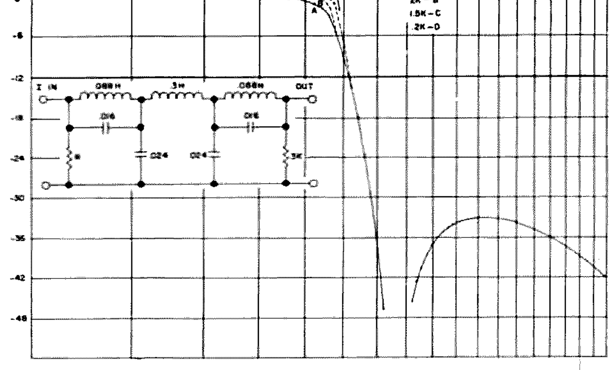


FIG. 3

cps by diode D_1. Narrow shift for identification is provided by push switch S_1 or a miniature relay for remote ID switching.

Q_4 is keyed to *mark* by a one-milliamp positive input current from any source over five volts. The change from *space* to *mark* is very sudden and non critical. Diodes D_2-D_4 protect Q_4 from loop voltage transients. The input may be connected across shunt resistors in the loop (100 ohms for 60 ma. loop; 300 ohms for 20 ma. loop) or directly to the "cold" side of a positive voltage keyboard as in K6IBE's TU-D (RTTY June 1963).

Calibration

Set S_2 to *mark* and adjust R_5 for a 2125 cps output. Now set S_2 to *space,* turn R_3 for highest frequency and adjust R_2 for 2975 cps. Because of variations in unijunction transistors it may be necessary to change C_1 to obtain the proper frequency range. With S_2 still in *space,* R_3 may be calibrated directly in cycles of shift down to about 100, depending on the exact characteristics of Q_1 and D_1. R_{12} is selected for constant output as the shift pot is varied over its range. With the oscillator connected to the loop, increase R_{23} just passed the point where marking occurs. Now turn your two meter beam towards Ohio and call K8ERV like mad.

. . . K8ERV

Gus-see p. 4

Bill Hoisington K1CLL
Peterborough, N. H.

Low Cost Solid-State Crystal-Controlled Modulated Signal Source with Infinite Attenuator for 2, 220, 432 and 1296 mc

These little units will allow you to do just about any and all low noise front end work you can dream up. You can also carry it in one hand and transport it to your friend's house and calibrate his low noise super-duper and compare it with your 416B, parametric or what have you, for absolute sensitivity. Results are stable and guaranteed equal to actual most extreme DX conditions on the air, including Moon-Bounce. Cut down from 1000 microvolts to 1/20th of a microvolt, 1/100, and on to absolute zero, on a smooth graduated scale. Sounds too good to be true? Yes, it does, but it works and we have several here operating F.B!

How It's Done

It often takes several new ideas working together to make a new device. Don't forget, well-known A and B put together in a certain fashion, can make highly patentable C! As in the following example.

A. A miniaturized transistorized, crystal-controlled, modulated signal source small enough to fit inside a waveguide (or any rectangular cross section metal tubing of correct size).

B. Metal tubing as per above, whose dimensions are such as to present infinite cut-off for energy on the frequency involved, such as 144, 220, 432, 1215, or 1296 megacycles. The length of course must allow for the attenuation, which is very high per inch!

C. Metal end caps on the tubing, with a coaxial connector on one end, and a hole for a slide-handle or push rod with a graduated scale on the other.

And that's it. Infinite attenuators have been made before, of course, but usually have required also fantastic amounts of shielding, power lead bypassing, etc., for the oscillator. But this one just slides into the waveguide, signal source, power supply and all. As long as it sits well inside the guide, with no conducting metal of any kind coming out it works fine. This is totally important. I mounted one of these on a long piece of copper-clad bakelite which I figured to use also as a push-rod. The results? N.G.! The signal came right out on the copper.

If you want to switch it on and off from the outside you will have to use a rotary switch and a wooden dowel extension.

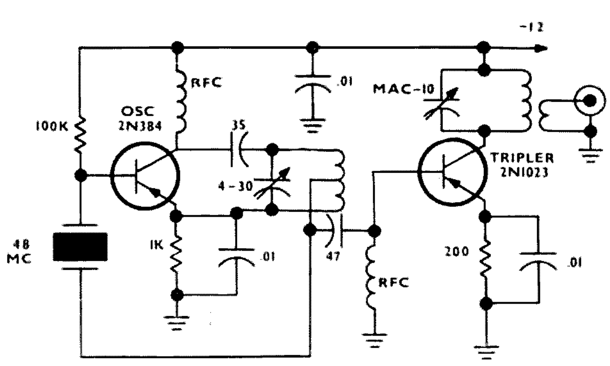


Fig. 1. 2 meter crystal controlled signal source. L1 is 7 turns airwound 16 tpi. Tap at 4 turns from cold end. L2 is 8 turns no. 16 copper airwound 3/16 inch id, 1 inch long. RFC is any good choke resonate below 48 mc.

Two Meter Signal Source

Fig. 1 shows this little unit which starts with a 48 megacycle crystal. The oscillator circuit is your present writer's favorite, the crystal phase reversing job. I have described this before, so this will be a shortie. If regenerative connections were used, that would put the emitter on the coil tap of L1, with the base on the end. Degenerative connections, as used, are the opposite, base tapped up on the coil, with the emitter on the end. However, due to the nature of piezo-electricity, the ac voltage on each end of a crystal is always 180 degrees out of phase, so, it not only oscillates but it will not take off anywhere ex-

cept on the crystal frequency. All other frequencies are highly degenerative.

The transistor used is a RCA 2N384. This type happens to be several years old but has always worked ok at 50 megacycles. It also saves my better units for 1296 where you really need the best.

The next one is a 2N1023, also RCA. This s a type that goes up past the 2 meter band. It also was on hand. Any good transistor honestly abelled UHF or even VHF should do all right in either of these positions. Incidentally, ockets are used. They work perfectly ok. Don't forget that germanium transistors should not really be soldered. With silicon units the manufacturer yells "What in the world are ou using sockets for?" You can even solder right onto the case!

In spite of my oft-voiced preference for doubling, tripling is used here because it works adequately for the purpose: a good signal on 2 meters. There is much more signal than you need for sensitive receiver tests. In fact, you could use less battery voltage. I ust tried it out, between these sentences, and find that 6 volts is as low as the unit described above will go. At that battery voltage the output is down to 20 microamperes as compared with 500 using a new 12 volt battery. As is however, it is nice for peaking antenna coils, rf stages alone, and on indoor antenna ranges. Outdoors too, if you use a receiver for one end of the range.

The tripler stage uses a 200 ohm emitter resistor and a grounded rf choke in the base with no dc excitation other than that furnished by rectification in the base-emitter circuit. The stage draws about one mil collector current while running.

A small copper-clad plate 2×1 inches is used to "launch" the signal into the waveguide. Again, there is more signal than needed for sensitive receivers. You could certainly omit the launching plate. An rf output jack allows maximum rf to be obtained for other test purposes. You can also use the unit as a local oscillator chain for a solid state two meter converter if you want to by changing the crystal and retuning a little. Use absorption frequency meters or a grid-dipper to do this. Better even use both!

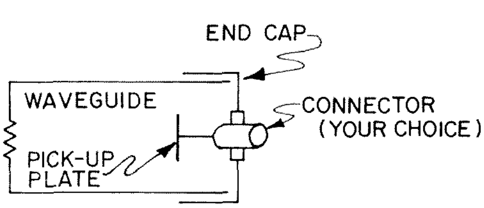


Fig. 2. Detail of pick-up end of attenuator

Construction of the Attenuator

As you may have gathered, you can simply take a piece of aluminum waveguide or aluminum drainpipe about three inches wide and about two inches high, by some 4 feet long, tape the signal source to a 2 inch wide by 4 feet long strip of quarter inch plywood, and push it inside. You'll see immediately what happens to the signal if you are listening on your low noise superhet. When the source is well inside the guide, that signal will disappear!

Actually, a little work on the deal is quite rewarding. First an end cap, coax connector and "pick-up" plate, puts the signal right where you want it, that is, into the rf jack of your pre-amp.

Fig. 2 shows detail. The end cap can be formed of flashing copper, if you're good at making metal boxes. I'm not. The cap can be fastened on with tape or metal screws. Solder a small piece of copper clad bakelite to the coax connector, bakelite side in, and away you go.

The real nice feature of this is that instead of putting the signal out in the barn in a tin can, or over at your neighboring ham's shack, you now get all the signal you want, or as little as you want, right at the input jack of your receiver.

Believe me, for rf stages there is nothing like it. (Never mind the "government type" HP generators at $3,000 to $4,000 a throw. How much money do you think I get for writing ham articles?)

At the other end of the waveguide you need another end cap, with a hole in it for the "push-rod" handle. I fastened the copper clad base plate of the generator to a piece of thin plastic and then attached a ½ by ¾ inch strip of wood 4 feet long. As seen in the photo this comes out the end, and can be used for calibration purposes. I'll leave fancy stuff to you, such as remote control switch, (use wood or bakelite) modulator switch, etc. Just remember, no metal of any kind. The ground plane base of the generator has plenty of signal on it.

Results

I checked out the various detectors, receivers and converters I have to see their relative sensitivities in "inches" of push-rod sticking out.

Now I can really find out about the absolute signal sensitivities of the following units around the shack. A. Crystal mixer, including noise comparison of all my crystals; B. 6AM4 rf stage; C. Ditto 6AN4; D. New 2,000 megacycle type transistor stage (at 432 of course); E. The half dozen 416B's that have been knocking around the shack for some years; F. My 417A's; G. Anything else I can think of, such as noise reduction by neutralizing.

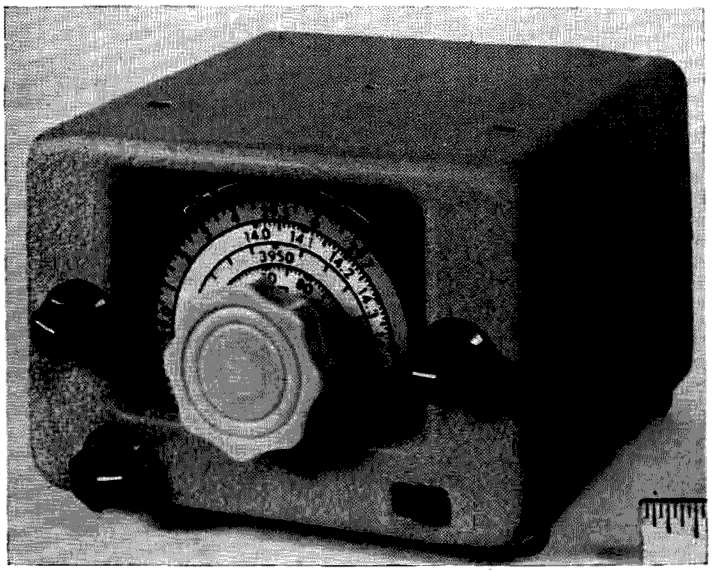
Using modulation on the generator, a simple absolute reference check can be made by using a scope on the receiver af output. Sync lock provides an exact reference level that is better than the human ear. Af wave on the scope versus "grass" of the noise can be used also. Signal level is varied by moving the push rod in and out of the waveguide. There is no use arguing with that set up! The complete receiver that locks on with the greatest distance is it! Don't change the af set-up while testing rf, of course. Voice recognition is another whole story yet.

Please excuse my not showing 220 megacycle units. It's just that I like to jump to 432. Then of course, you have to jump to 1215 or 1296. 220 should be easy, just put in another crystal and coils.

So that's all for now, yours for better noise figures.

. . . K1CLL

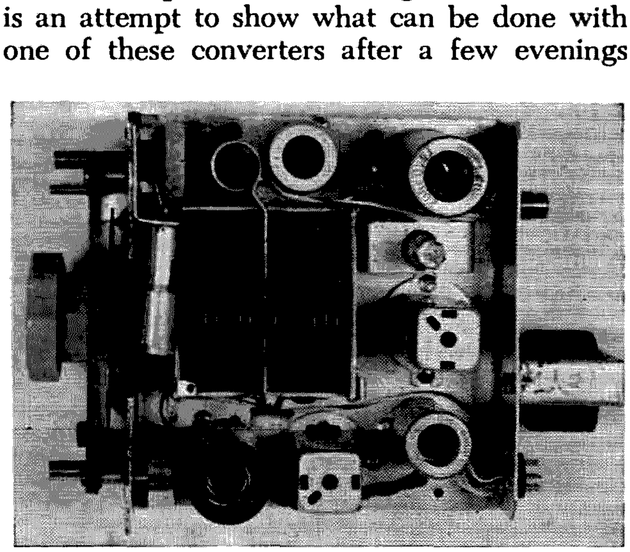
William Kennedy W3ZFJ
1520 James St.
Monroeville, Pa.



The Converted Converter

Turn a Gonset Tribander into a complete receiver.

There have been many articles on conversion of surplus equipment and a few on conversion of old commercial equipment. Here we present a conversion of a converter. I picked up my old Gonset Tribander one evening and wondered what could be done in the way of making a receiver out of it. Out came the paper, slide rule, and coffee pot. I started figuring gains, bandpass circuits, tracking, and etc.; and came up with this little gem. This article is an attempt to show what can be done with one of these converters after a few evenings at the work bench. This little package, requiring only a power supply and speaker to be complete, can hear anything on ten meters that my 75A-4 can hear. This is where the comparison ends however, but in 10 meter mobile, you need little else.

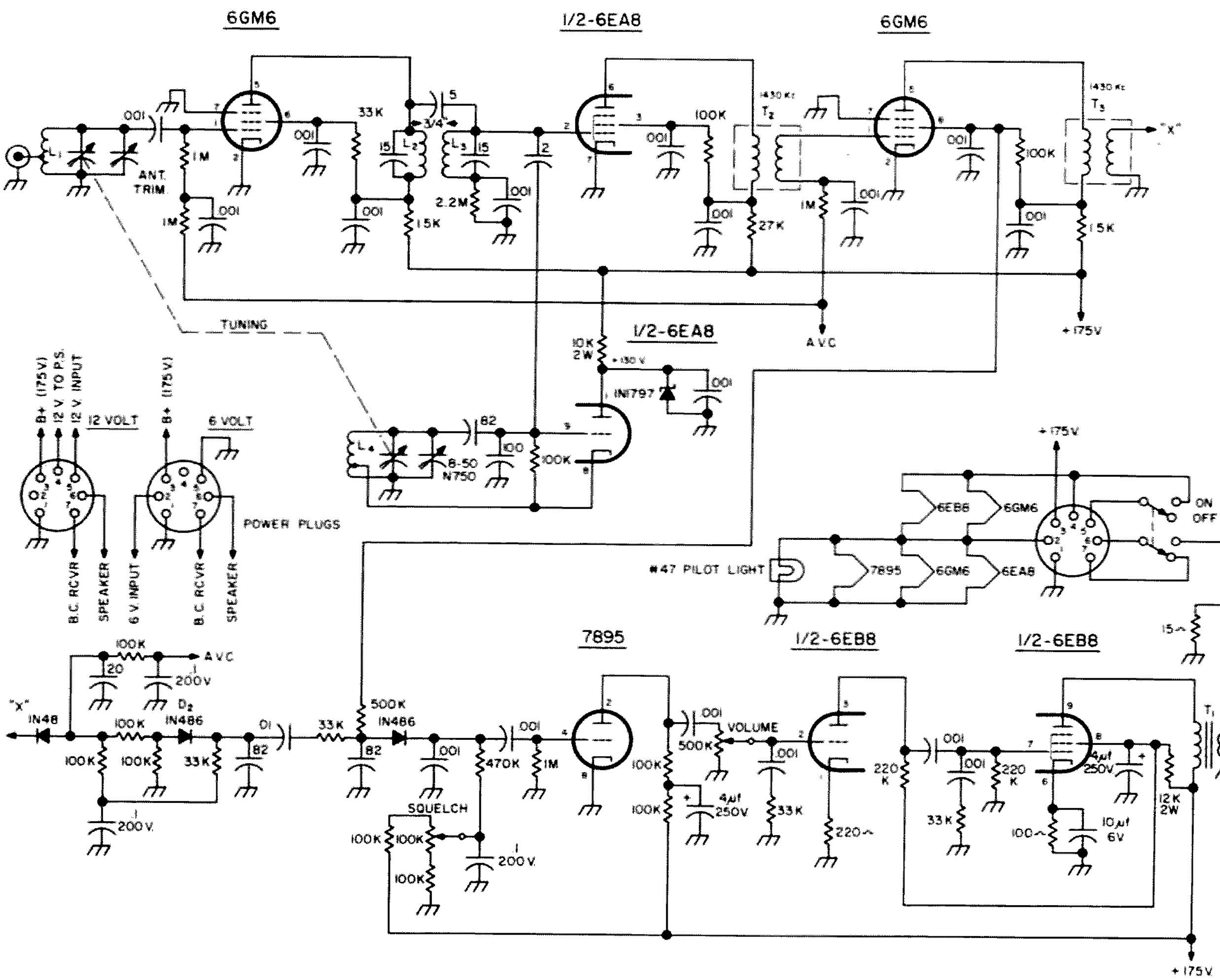


Top view of Converted Converter receiver

The Gonset Tribander with its four tubes, when installed in the family chariot, required six or eight tubes in the BC set plus two more for the noise limiter. That is a lot of tubes and power, especially if you are interested primarily in one band. *This* receiver requires only 150v to 175v at 50 ma and 12v at 1 amp. The circuit in Fig. 2 may be used to power the receiver from the 110v line, and the circuit in Fig. 3 may be used in the car.

The receiver circuitry is simplicity itself. The tribander was used because I had one on the shelf but any of the Gonset converters will do just as well. Only the dial, tuning capacitor, rf coil (10 m), oscillator components, and the "screw in the upper left hand corner" were used. The entire chassis is stripped including tube sockets.

Fig. 1 will show the circuit is quite conventional, consisting of a 6GM6 rf stage, a 6EA8 pentode mixer with the triode section as the local oscillator. The *if* amplifier is an



The Converted Converter

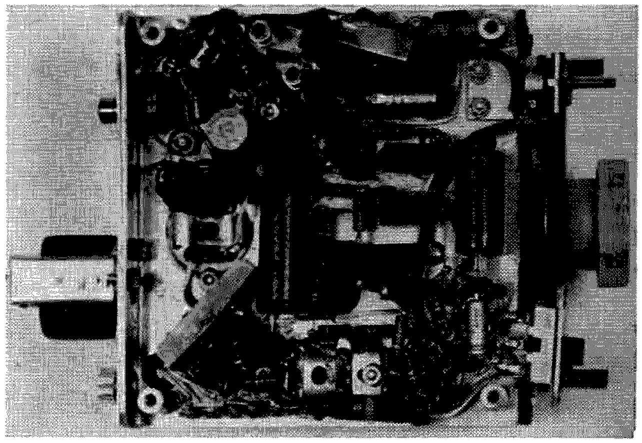
ɔther 6GM6. The intermediate frequency of 1430 kc was retained in order to preserve the ɔriginal dial calibrations and tracking. As you nay probably guess, the secret of the pheıomenal sensitivity of this receiver is obtained ɔy using high gain tubes in the first three tages. The 6GM6 has a transconductance of .3,000 μmhos and the 6EA8 pentode has a ·onversion gm of about 4,000 μmhos. This, oupled with a high Q input circuit, results in . lot of gain with a few tubes. After the deector is a silicon diode rate of change noise imiter, followed by a 6EB8 first audio and ·ower out-put stage.

The original antenna coil is mounted on he variable capacitor (front section) next to he antenna trimmer. The ground end is ɔldered to the top of the capacitor frame and ıe antenna tap is one turn down. Once the ntenna trimmer is tuned for maximum in the enter of the band, the main tuning will track ver the entire band.

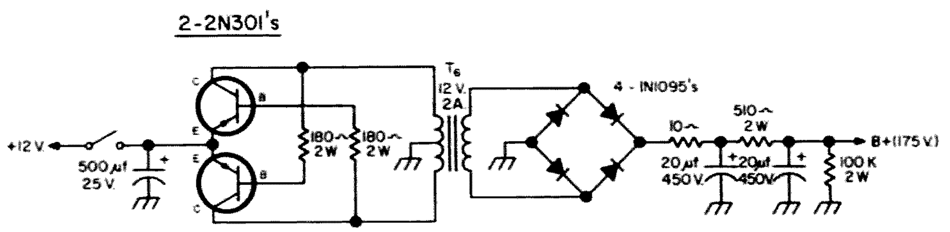
Note the absence of cathode resistors in the rst three stages. The bias for all three stages : made up by their respective grid resistors. 'he values are large enough to provide the roper bias by contact potential.

The plate of the rf amplifier is a double tuned broad band circuit. One coil is peaked at 29.2 Mc and the other at 28.8 Mc. The coils may be purchased already wound but if you have a couple forms of this size, coil winding data is given. The coils should be mounted about ¾″ apart.

As mentioned earlier, the original oscillator components are used. They must be carefully removed if they are to be used. I re-



Bottom view of receiver



12 vdc
power supply

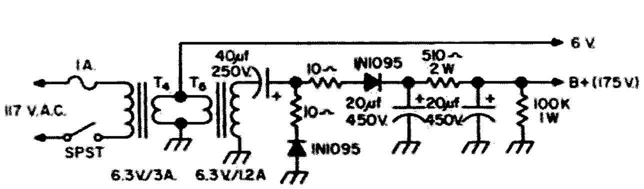
placed the 82 pf and 100 pf negative temp. capacitors with silver micas; however, I retained the 2 pf oscillator injection capacitor. An added refinement is the 1N1797-130V Zener diode to voltage stabilize the oscillator. This may be left out, or a VR105 may be added in the power supply. A band set trimmer is mounted on the variable capacitor frame next to the 6EB8.

The variable capacitor will tune over a much wider range than we need, so a band edge stop must be installed. This may easily be done by removing the dial plate from the main shaft and replacing the set screw with a ½" 4-40 bolt. The bolt will stop at each end of the band on the shaft of the tuning capacitor. Take care to replace the dial in the same place as it was or you will upset the tracking. One last point in the oscillator section; don't forget the 2 pf oscillator injection capacitor to the mixer. I did, and spent several days trying to find out why the receiver was so insensitive.

The mixer is a relatively new tube and is straight-forward circuitry. There is a new bottle out by RCA I will try sometime in the near future in this circuit. It is a 6KE8 triode and frame grid pentode. The gm of the pentode is 12,000 µmhos and is designed for high gain mixer circuits. The *if* amplifier (only one) is conventional.

Now we come to the noise limiter and squelch circuit. The noise limiter is the Rate of Change circuit that appeared in Dec. 1962 of 73. Note that the two input resistors have been increased to 100 k. This gave me more output and a greater degree of noise suppression. I make no claims that this is an improvement, only that it's different.

The squelch is nothing more than a diode switch. It lets the audio through when conducting and cuts it off when its non-conducting.



AC power supply

I could go on about this circuit but K4UWX described it at great length in his article "Simple Squelch" in Nov. '62 of this magazine.

The 6EB8 in the audio stage takes the place of the usual 6AQ5-12AX7 combination in that it combines power amplifier and voltage amplifier in one bottle. The receiver didn't have quite enough gain in the audio section so a 7895 nuvistor was added for more gain. As you can see in the photograph, it is mounted under the chassis up next to the rf stage.

The input connector is an amphenal miniature "CP" series 7 pin plug mounted in a tube socket ring. The tube socket became the female cable connector. It makes a very small multi contact connector.

The slide switch on the front panel switches the 12v to the filaments and to the output connector to energize a relay in the power supply. The other half of the switch connects the car speaker either to the receiver or to the bc set. Incidentally, if anybody is partial to the TNS noise limiter and squelch there is plenty of room under the chassis if you use a pair of silicon diodes and a pair of 6CW4 nuvistors.

This receiver has performed trouble free for about 6 months and is still going strong. A matching transmitter with vfo, screen modulator, and a power input of 100w is under construction in another converter case.

. . . W3ZFJ

Parts List

- L1 original antenna coil, antenna tap 1 turn
- L2, L3 12T #30 wire on 3/16" ceramic iron slug form, spaced ¾" apart. or Miller 4300 form or 4306 coils may be used.
- L4 original oscillator coil
- D1 1N1797 Zener Diode
- D2, D3 Texas Inst. 1N486 or Hughes 1N426 silicon diodes
- T1 10K to 4 ohms output transformer. Stancor A-3879
- T2 Miller 13-W1 1500kc if trans.
- T3 Miller 13-W2 1500kc if trans.
- T4 Thordarson 21F10
- T5 Thordarson 21F09
- T6 Thordarson 26F67

73 Tests the Galaxy V

It's driving me out of my mind. The V arrived just a few days ago on loan for evaluation. I was quite surprised at how small it was . . . it looked so big in the ads. Instead of setting it up down in the ham shack I decided to put it on a small typewriter table by my desk and feed the antenna up through the floor.

Frankly, since the Galaxy V is the lowest cost five band selectable sideband transceiver, I expected to be faced with all kinds of miseries in operation. Not a problem of any sort has turned up.

My first try was on 3999 kc, probably the most aristocratic frequency of all the hambands. After a careful examination of my signal on their scopes I was admitted to this elite group and permitted to talk freely with the assembled M-2's. Had there been untoward carrier, unwanted sideband, or distortion I never would have made the club.

That night I tuned up on twenty meters . . . Oh, by the way, the V is a snap to tune . . . even old fumble-fingers me got the hang of it right off. My first call was YV5CEI. When we finished I got trapped by two fellows down Boston way . . . 73 readers . . . and I got another hour behind on my work. This having a rig by the desk is bad news . . . it is too easy to flip it on just to see who is there . . . then I *have* to call in and say hello to some old friend. Yes, I do have some friends.

One control that is left off some of the transceivers is the one for switching sidebands. Sure, you don't need it often, but when you do you do. One of the first stations I heard on 75 was using the upper sideband instead of lower and I switched him in with a chuckle to myself, thinking of all the fellows who could hear the noise, but couldn't tune it in. Obviously this is quite advantageous on CW, where at least one side of the station you are working has a little less QRM than the other.

This brings up another considerable advantage of the Galaxy V . . . CW. Many of the transceivers are designed strictly for SSB . . . some permit CW, but don't let you tune the entire CW part of the ham bands. The V covers not only the entire ham bands, but overlaps enough on most bands to permit MARS operation, reception of CHU, and stuff like that. Specifically it tunes from 3.5-4.0 mc, 7.0-7.5 mc, 14.0-14.5 mc, 21.0-21.5 mc, 28.0-29.0 mc. Crystals are available to allow the V to tune other frequencies of course. CW ops will be glad to note that the rig runs 300 watts and that they've shifted the carrier 1 kc into the passband to eliminate "leap-frogging."

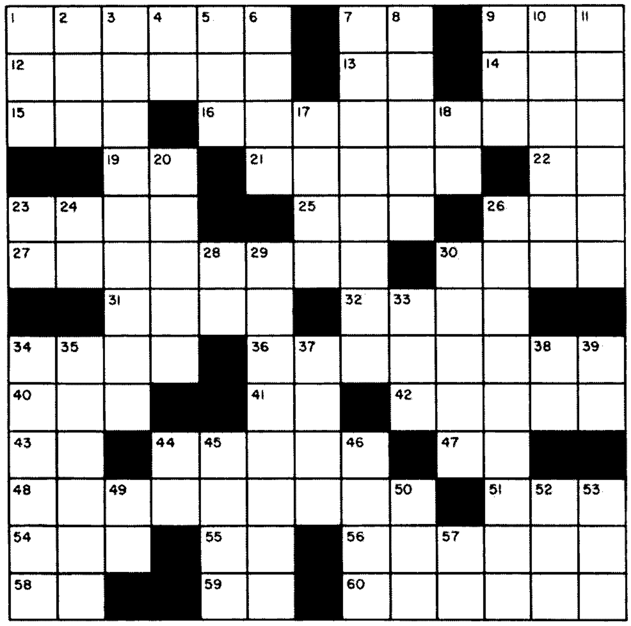
Galaxy uses transistors for the audio amplifier, driver and output circuits and in the accessory vox plug-in unit. Not caring for vox myself, I am glad to find it now is optional. The transistors considerably cut down on the size of the unit; good move.

Though I've been conditioned to rely on Galaxy's advertised specs, I still wanted to see if this little black box could really put out 200 watts into my dummy load the way they said it could. In the CW position my Waters Dummy (no offense) Load Wattmeter read 200 watts right on the nose. The wattmeter doesn't read PEP watts (whose does?), but if it will put *out* 200 CW watts I guess it doesn't have any problem mustering up the 300 SSB watts input they claim.

Perhaps it isn't even necessary to bring this up, but the Galaxy V is every bit as stable as you could ask. I only mention this because I've gotten tired retuning the fellows I'm talking with after each transmission on another make transceiver that I've been using. That one is not in current production, so don't worry about it. The Galaxy V, even when freshly turned on, stays right on frequency. Good show.

. . . W2NSD/1

Clever Philological Quizze



Max Winter K2PIJ
2444 Barker Avenue
New York 67, New York

Across:

1. Colored thread used in wire insulation to aid in identification
7. Abbreviation for radio bands at a higher frequency than broadcast
9. Classified notices
12. Vacuum tube having a specified number of electrons
13. Greek letter having many electronic applications
14. Type of coil winding
15. A square of butter
16. Clipping circuit in TV receivers
19. The: (Spanish)
21. Challenges
22. Marine officer (abbr.)
23. ———— fide
25. Periods of time (abbr.)
26. One side of a ship
27. Slang for microwave coax circuit
30. Physics term concerned with weight and acceleration
31. Mimic
32. Interjection
34. Reclines
36. Rhetorical comparison of negative and positive
40. Numerical value of brown
41. Continent (abbr.)
42. Speaker parts
43. Symbol for cerium
44. Adjust the beam in a cathode-ray tube
47. Continent (abbr.)
48. Units of electromotive force
51. Golfing equipment
54. University degree
55. Symbol for erbium
58. Symbol for tellurium
59. Compass direction
60. Wheatstone circuit used to measure impedance.

Down:

1. Portion of a hill best suited for microwave tower
2 Prominent electronic manufacturer
3. Reduce the strength of an electrical impulse
4. Symbol for cobalt
5.5Man's name (plural)
6. Type of frequency meter
7. Arrangement of two electrodes used in early type transmitters
8. Paths for electric current
9. Liable
10. Type of tubes
11. Method of arranging circuit parts
17. Chess piece
18. Like
20. Sources of electric illumination
23. Temperature constant for a liquid
24. Electrical protective device (abbr.)
26. Type of iron core
28. Metal winding in some types of geiger tubes (abbr.)
29. Type of transformer
30. Sub-atomic particle
33. Chemical elements in hydrocarbons
34. Mounting device for tubes
35. Interior
37. Man's name
38. Symbol for tellurium
39. ———Q: abbreviation for Mister
44. British State Department (abbr.)
45. Heated enclosure for a quartz crystal
46. Open impedance path between two conductors
49. Unit of weight (abbr.)
50. Spanish for Mr.
52. Electronics expert (abbr.)
53. Summer: French
57. Symbol for bismuth

Solution on p. 90

Letters

(Continued from page 65)

Dear OM,

Yesterday, when I returned home from the University of Iowa, I grabbed up the waiting March issue of "73"—a real bombshell. I was really surprised to see the first column and a half in the "de W2NSD/1" dept. devoted to "flying sorcerers." Apparently you have become interested enough to dig beneath a veneer of government smoke-screening and crackpot factions. Welcome to one of the biggest mysteries of the twentieth century.

The implications of the presence within our atmosphere of these strange, unknown objects are overwhelming if you have the courage to really think about it. And there is abundant and continually accumulating evidence that the objects are real, made by and controlled by intelligence, and that they do not originate on this planet; this regardless of what the Pentagon people preach.

Sooner or later, the populace has to find out, and the longer the government keeps playing games with the public, the worse it's going to be when finally it gets too big for the Pentagon boys to sit on.

Just in case you get more response on the saucers than on RM-499, and are stuck for references to reliable data on UFOs, may I suggest the National Investigations Committee on Aerial Phenomena, 1536 Connecticut Ave., N.W., Washington 36, D. C.? Perhaps you have heard NIAP, a private member supported organization, mentioned in some of your serious discussions about UFOs.

As you blaze away in the pages of "73" against the woes that beset the present and future of amateur radio, so has NICAP been crusading for recognition of the reality and the significance to humanity of the UFOs. NICAP has been plugging away for over eight years despite the government clamp down of significant data, and various attempts to discredit the group. Now things are beginning to pay off, especially with the current height of UFO activity in this country. The activity promises to exceed the much publicized saucer "flaps" of the early & mid 1950s, although the lack of news coverage wouldn't indicate this. And the Washington sightings are starting the new year off with a bang, as you well know.

NICAP is international in scope, with over 5,000 members, of which I am one. The group is non-political, non-profit; NICAP is dedicated to the belief that there is something going on in our skies which we should all know more about, MUCH more about. If you are interested in following the current situation, I suggest you join NICAP, or at least get a copy of their 1964 publication, "The UFO Evidence." It is an outstanding contribution in factual reporting, and is the result of years of investigation and evaluation of myraid UFO cases. I can pretty well guarantee that if you read the evidence, you will do some profound thinking about the whole UFO subject. Perhaps "73" will feel disposed to run a monthl column on the subject; "Green's Little Green Men," o something. Hi!

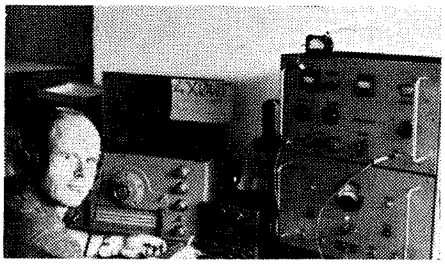
William H. Hunkins
IoAR NICAP
WA5EKQ/WAØKOM

Gentlemen:

DX-pedition may at times be an overworked expression, but I have one to report which is a "first" in the Pos World War II Era from SP-land. Andre K. Krzysztofi SP5ALG took part in a DX-pedition from Poland vi the Mediterranean to the Dead Sea area in 4X4-land. Andre SP5ALG left his native land on June 9, 1964 with a home-brew 200-watt rig, a Drake 2B receiver and long-wire 80-meter antenna. After visiting such countrie as SM, OZ, DL, PAØ, CN8 and 7X2 (ex-FA), his firs transmissions enroute were from Sousse Tunisia with th call sign 3V8GM. A few QSO's were with W station out of mort then 200 contacts made from Tunisia. Enroute from 3V8 land to Israel, he touched on countries such as OD5, YK, and JY. While in Israel he was granted permission to operate with the call sign SP5ALG/4X4WF.

Together with Dr. Eric Friedman 4X4WF ex-SP6WF, he operated a DX-pedition station from the Dead Se area with the call sign 4XØWF. The prefix 4XØ was used for the first time in Israel. Andre and Eric operate

SP5ALG



4X4WF

4XØWF for 60 hours continuously on October 18, 19 and 20, 1964. Unfortunately, conditions were very poor during the time that station 4XØWF was in operation; otherwise any more contacts would have been made. U.S.A. sta-ions were worked on the 7 and 3.5 megacycle bands. Due to the depression of the land, conditions to Europe and to North America were very poor. Except for very heavy QRM from U stations, conditions to Oceania and Asia were very fine business. The prefix 4XØ is new for WPX. This DX-pedition was a very interesting one from the standpoint of QTH because the Dead Sea is located 1200 feet below sea level.

A couple of days later, Andre obtained for a call sign X4UJ and made scores of contacts from the City of aifa. Andre left Israel November 25, 1964 for the U.S.A. via such countries as I, EA, ZB2 and EA8. He now hopes o obtain operating privileges on the ham bands. This stems rom the fact that the U.S.A. has entered into reciprocal greements with countries which allow U.S. radio amateurs he privilege of operating in their respective countries. All QSL's will be answered 100%; these include all QSO's made with ex-SP5ALG, 3V8GM, SP5ALG/4X4WF, XØWF, and 4X4UJ. Please address all QSL's via W2VLS.

W2VLS

Improving the 4-Band KWM-1*

Dear Wayne:

The following improvements have been made to my expanded KWM-1 resulting in all controls being on the ont panel and no frequency jump when switching side-ands.

Replace R-115, the anti-trip pot with a Centralab FI-0K. Use a matching Centralab shaft thru it to actuate e switch in the final compartment. If you did not align e two, use a flexible shaft coupling to connect them.

Replace R-92, the mike-gain pot, with a Centralap FI-00K and matching shaft similar to the anti-trip control. Replace the SPDT slide switch for switching sidebands with a DPDT switch same size and same place. Connect e center of the second pole to ground and connect the pper sideband contact to a 36 pf capacitor in parallel with a 4-12 pf trimmer. Connect the other end of the apacitor and trimmer to pin 7 of V-22.

Connect the slide switch actuator to the shaft thru R-22 with a piece of piano wire so that you can operate e switch. With a little bushing or some shim stock ou can use the original knobs on the 3/16" shafts. I cut iscs for the knobs for the concentric pots of ⅛" plexi-lass. You can probably get some concentric TV knobs o fit.

When you are through, tune in the calibrate note and djust the trimmer so that it is zero beat on both side ands.

* Four bands on the KWM-1' "73" Dec, 1963 pg. 60

Lou Weber K6GHU

Dear Sir:

The Korean Amateur Radio League and the Eighth United States Army Radio Club will jointly sponsor a Field Day from 0001 GMT 3 July to 2400 GMT 4 July 1965. A special QSL card will be issued and all amateurs are encouraged to participate. Listening for 20 meters phone will be on 14.200 MC and above and transmission on 14.185 mc and above. Operations will also be on 15, 40 and 80 meters. AM, SSB and CW will be utilized. The station in each U. S. call area contacting the most HL or HM stations will receive a special certificate. The Kimchi award will also be granted for two way contacts with five HL stations. Send extract of logs to HL9US, HQ EUSA, Signal Officer, APO San Francisco 96301.

C. M. Moorfield
HL9KG/KH6FIG

Dear Wayne:

In September of 1964 the first licenses for the Americans on Ascension Island, South Atlantic Ocean were granted by the local government. About December we formed a club called the AARL (Ascension Amateur Radio League) of which I was elected first president. At present there are about 15 licensed amateurs on the island of which there are about six who are active. I guess you have heard some ZD8 activity and this is the brief story.

Unfortunately, BCI, Hi-fi itis and tape recorder interference has kept most of us fairly inactive We live in barracks here and in order to keep peace among our coworkers we do limit our operation when we have interference problems. We'd like to eliminate this interference and maybe increase the activity from the DX spot.

Ascension Island is about 32 square miles in size. It is of volcanic origin and the soil that does exist is not very conductive for grounding purposes. The barracks area is located about 1 mile from the ocean so there is no way to throw a positive ground into the ocean. The ground that we have to use is an instrumentation ground that is run between all the barracks and various sites that are scattered all over the island. This common loop and ties of ground is finally connected to the ocean at about 5 places around the island. There is also a power ground that runs to all the buildings, which is supposed to connect to the instrumentation ground, which depending upon the point it is measured will show a voltage between this power ground and the instrumentation ground. This is the real problem, the ground system or lack of an efficient one.

I have put much work into trying to eliminate this interference. My transmitter is a DX-60 and I have a Drake 2B also. Presently I'm using a long wire with a tuner but hams using a dipole with coaxial lead experience similar difficulties as I do. While my station has been operated by the other hams, I have made measurements with the Heathkit Tunnel Dipper to get an idea of my field strength. I find that I lose the signal or it drops off sharply after 100 ft away from the shack or antenna that is until I bring the dipper near a power line and then the signal shows up strong. I know that the signal is being transmitted all around the base area this way as you may say that we have effectively a floating ground system which is being loaded by our transmitters. Even using the five six foot ground that I have outside my room this still occurs. One ground rod gave between 200 to 300 ohms difference between it and the base ground and with the fourth and fifth it remains close to 30 ohm difference. One of the members seems to recall an article in your magazine about an artificial ground system and I'd appreciate a copy of this, if available, so that we may try this and see if it helps our situation any.

Maybe I have made this sound a little worse than it actually is. There are some sets that have been cured of interference by the standard methods of 0.01 across each side of the line to ground and also by something like a 100 pf from the first audio to ground, but there are still enough sets that still experience interference and cannot seem to be completely cured by conventional methods.

Your help will be appreciated by many and I hope that it will enable ZD8 land to become a bit more active. Thank you.

Ralph ZD8RH

W2NSD/1 from p. 2.

letters, not me, and he, not me, is thus immune from legal action.

If you are interested in getting a copy of the K6BX Extra News Letter #21, twenty-two large sized pages typed three columns to the page with Clif's extra small type, and packed with dynamite which may sweep the present headquarters heirarchy out of office, then send 50c for each copy (buy several and get the word spread) to K6BX, Box 385, Bonita, California.

Columns in 73? No, no, no, no, no, no!

Yes.

I can't fire 80% of you just because you disagree with me, and that was the percentage that answered the February questionnaire with suggestions for columns. Why you want me to louse up a good ham magazine with that sort of junk I can't imagine, but you do and I will and you'd darn well better keep reading the magazine after it gets junked up. As a matter of fact, you should make it your business to talk some friends or enemies into subscribing to make up for any of the 20% who wanted the magazine to stay the same that drop out in medium or low dudgeon.

What columns are we going to sprout? Well, I really don't know. That all depends upon our finding volunteers to write the columns. I figure that we really should have top experts for each field we try to cover. For instance, our propagation column is prepared by John Nelson who is recognized to be one of the foremost experts in the world on radio propagation. The Bureau of Standards only wishes that they could predict as far ahead and as accurately as John does in 73. His predictions have, time after time, been startlingly accurate when compared to predictions in other magazines.

Since 40.0% of you have requested a VHF column we obviously should have something along this line. I really don't know who should run the department. I'll try to come up with someone interesting. 32.4% requested a column on transistors. Hmmm. I guess we're in a good position to turn out something like this ourselves. Watch for a transistor column headed by Paul Franson WA1CCH, who also masquerades as Assistant Editor around here.

Before you get all excited over 73 filling up with all of this special interest stuff, let me explain what I actually have in mind. Rather than running two, three or four pages each month on each subject it seemed to me that we might be able to present the latest news of interest in something fairly short and

concise . . . something quite akin to the Station Activities segment of QST in looks, though one would certainly hope that it would be more interesting in content. If we devote about a half page to each column then the whole works shouldn't take over two or three pages about the same as other magaines devote to one single column.

Club Stations

The following exchange of letters will be of interest to all ops who plan to operate a club station or to operate any multi-operator station in any contests in the future.

Institute of Amateur Radio
26 January 1965

Secretary
Federal Communications Commission
Washington, D. C.

Dear Sir:

The Institute of Amateur Radio, Inc., a non-profit New Hampshire corporation with somewhat over 2500 licensed amateur members is planning on applying for a club station license with myself, the Secretary of the Institute, as trustee.

May I please have your decision on whether it will be legal for the Institute to permit operation of the club station by operators other than the trustee of the station with the trustee not in control of the station?

May I also have your decision on whether it will be legal for the Institute to permit operation of the club station by paid amateur operators?

I assume that both of these are legal since the precedent has been established by the ARRL with their station W1AW, but I wanted to be sure before any great investments were made in equipment and antenna arrays.

Yours truly,
Wayne Green W2NSD/1
Secretary
Institute of Amateur Radio

FEDERAL COMMUNICATIONS
COMMISSION
Washington, D. C.
20554
February 9, 1965

Mr. Wayne Green, Secretary
Institute of Amateur Radio
Peterborough, New Hampshire

Dear Sir:

This is in reply to your letter dated January 26, 1965, concerning operations in the Amateur Radio Service.

You are advised that, to meet his responsibility, the trustee of an amateur club station is not required to personally suprevise and control all operations under the club's call sign. Instead, the trustee may delegate certain supervisory activities to a station manager or to other responsible club members. This leeway is permitted since the nature of a club's station operations often renders it impractical for the trustee to be in a position to exercise direct control at all times. The trustee is, however, expected to be able to assume direct control of the club station if it should prove necessary or expedient. He should also generally supervise operations by checking the station log, testing the equipment, assuring that the station is inaccessible to unauthorized persons, etc.

An amateur operator who has a pecuniary interest in his license or who receives material compensation for operation of an amateur radio station is in violation of the Commission's rules and is, therefore, subject to the imposition of severe administration sanctions.

Very truly yours,
Ben F. Waple
Secretary

February 12, 1965

Secretary
Federal Communication Commission
Washington, D. C.

Dear Sir:

Your letter of February 9, 1965 would seem to indicate rather unarguably that an amateur may not operate an amateur radio station for pay.

Yet I am faced with the seeming contradiction of the operation of amateur radio station W1AW, the official station of the American Radio Relay League, Inc. W1AW has been in operation for many years with, I must assume, paid operators. Of course there is always the possibility that some sort of transparent fiction has been used to circumvent the law.

Please tell me under what arrangement W1AW is able to operate with paid amateur radio operators so that the Institute of Amateur Radio, Inc., a non-profit New Hampshire corporation for the benefit of amateur radio, can establish its own official club station for use in transmitting code practice and messages of specific interest to all radio amateurs.

Very truly yours,
Wayne Green W2NSD/1
Secretary
Institute of Amateur Radio, Inc.

As you can see, the FCC has decided, in an interesting exercise of illogic, that although the licensee of an individual amateur station must be in control of the station if his call is to be used, in the case of a club station the club call can be used with all operators. even with the station trustee not present or in control.

Applying this new interpretation of our rules to contest operations, such as Field Day, we find that club calls can be used where the club has a license of its own, but that in cases where the call of a member would normally be used the operators must each use their own call when operating. The ARRL has indicated that they intend to do battle with the FCC on their interpretations of the rules because the new "rules" will cause considerable difficulty to their contests and awards. Tsk, tsk.

$100 Reward

The slides I took while DXpeditioning on Navassa during the KC4AF operation are of great sentimental value to me and I will pay $100 for their return, no questions asked. Last known whereabouts of the slides: CQ had 'em and refused to part with them.

We Want Money

A letter from one of our authors suggested that I take a quick survey to find out how many other authors are owed money by one of our ham magazines. Apparently one of our competitors is considerably in arrears. If all of you who are owed money for published articles will drop me a note giving the name of the magazine, the month and year published and the name of the article I will try to put together an "arrears" figure and publish it in 73. I will not embarrass you by publishing

'ou name or call . . . all I will give will be he total figure reported to me.

Late News

More news on the million dollar libel suit acing Huntoon and ARRL. Last month I re-orted that an expensive law firm had been etained by the League to fight the case. Now understand that none other than Louis Nizer ; to be their counsel . . . and the last I heard is fees start at around $25,000. Well, the case gainst them looks formidable to me . . . John eally put his typewriter in it this time in a etter to all member clubs (one of his famous Dirty Letters") and the entire League has to ay for this blunder. Watch for full details ı QST . . . hi.

I understand that three Directors are shop-ing for a new general manager.

Re RM-499 . . . no new news. All is quiet. tay that way.

Our DX column starts this month on page The mails permitting, we will have a month-letter from Gus telling us what major things e going on and what he is hearing from up ıere is Bhutan. I never would have suspected ıat anyone would have a DX column edited om AC5 land. . . . Wayne

More New Products

Rub-on Drafting

A fast new way to draw perfect schematics is now available. It is made by Datak and is called the "Electronic Drafting Symbol Set." It includes all common schematic symbols letters and numerals according to MIL-STD-15-1A. This newest dry transfer marking set features a special heat-proof adhesive that will withstand repeated passes through the hottest diazo whiteprinters with no cracking or fraying. Schematics made with this set are so crisp they appear to have been inked and then photographically reduced. The complete opacity of the transferred patterns results in flawless reproduction by any method. Each set contains a complete assortment of 40—5 × 7 inch sheets. Refills assorted to order are available. Electronic Drafting Symbol sets are $15.95 complete (Catalog #970). Get more data from the Datak Corporation, Guttenberg, New Jersey.

Quig

Sprague is giving a little bonus with their Atom Electrolytic Capacitors. These little connectors fit on cut leads for easy repairs. They are small springs made of a special wire that has a copper-covered steel core, a layer of flux and an outer jacket of solder. They're mighty good for initial wiring and replacement of parts in almost inaccessible places.

Solution to puzzle on p. 80

T	R	A	C	E	R		S	W		A	D	S
O	C	T	O	D	E		P	I		P	I	E
P	A	T		S	E	P	A	R	A	T	O	R
		E	L		D	A	R	E	S		D	I
B	O	N	A			W	K	S		L	E	E
P	L	U	M	B	I	N	G		M	A	S	S
		A	P	E	R		A	H	E	M		
S	I	T	S		O	P	P	O	S	I	T	E
O	N	E			N	A		C	O	N	E	S
C	S		F	O	C	U	S		N	A		
K	I	L	O	V	O	L	T	S		T	E	E
E	D	B		E	R		U	N	B	E	N	T
T	E			N	E		B	R	I	D	G	E

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★ Price—$2 per 25 words for non-commercial ads; $5 per 25 words for business ventures. No display ads or agency discount. Include your check with order.

★ Type copy on standard size paper. Phrase and punctuate exactly as you wish it to appear. No all-capital ads. Include your signature with order.

★ We can only accept ads related to ham radio. We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.

★ For $1 extra and an SASE, we can maintain a reply box for you.

★ We cannot check into each advertiser, so Caveat Emptor . . .

CLEANING OUT SHACK-Transistors, diodes, etc. Send list of required units or write for list of units on hand. WA5FYF, 4336 Linvingston, Dallas, Texas, 75205.

INDIANA HAMFEST: and picnic, July 11, Brown County State Park, near Nashville, Indiana. Come.

HAM MISSIONARY WITHOUT RIG will soon have one if you send your contribution to Brother Thomas Radio Fund, Walsh College, Canton, Ohio. Brother Thomas Paquet K1RCE of the order that directs Walsh College teaches in Bukoba, Tanzania (Box 95).

SAVE $75. NEW Drake TR-3 and AC-3 supply $525 plus shipping. First check takes it. Robert D. Corbett, 46 Prospect St., Torrington, Conn. 06790.

HAM TV Deflection & Focus Coil Kit with complete Instruction Mannual of a 5 tube Vidicon Camera for only $16.95. Send 10c for information. ATV Research, P.O. Box 396, South Sioux City, Nebraska, 68776.

GOLD—You will find a "Gold Mine" in our used equipment. Write for list. W9KP—Green Mill Radio Supply, 145 W. 111th St., Chicago, Illinois 60628.

COLLINS 75S-1 with 500 cycle CW filter. Perfact condx with power cord and manual. $325 C. Boutell, 3059 W. Ruskin Ct., Milwaukee, Wisconsin 53215.

HALFWAVE DIPOLE ANTENNA. Custom built to any frequency you request. Complete with 50' of coax. 2 KW PEP capacity. $5 postpaid. Adiabatic Enterprises, Box 151, Albany, California.

HW-12 with Heath AC power supply, like new: $150; RME 6900: $150; Collins 310B, all bandswitching: $75. Irvin Weinman, W9HMO, 4718 N. 80th St., Milwaukee, Wis.

WANT Communicator I, II, III or IV. State condition and price. Lile G. Wismer W3DKR, 442 N. Main St., Sellersville, Pa.

RTTY SALE: Model 15, table, P/S, $85. Model 14 typing reperforator, $60. Model 14 TD, $30. All $150. K1AJE, Bcx 829, Haley Rd., Kittery, Maine.

BAMBOO FOR QUADS: Highest quality Calcutta bamboo. 18 to 20 ft. lengths cut to 14 ft. Straight with no cracks or splits. Set of 8, $15.95 FOB. George Faltin K2PNR, PO Box 137, Syosset, L. I., N. Y.

NC-183-D, Eico 720 and 10-40 Mosley vertical. Very good condition. FOB your QTH. $200.00. Frank Levering K7PFV, P.O. Box 449, Hayden, Arizona.

GLOBE 300A with instruction manual. No shipping $125.00. W1FDN, Reading, Mass.

QSP far and wide April Extra News Letter exposes ARRL political rot and scandal from 1958 to date. Documented for Historical record. 50c copy. Clif Evans K6BX, Box 385, Bonita, Calif.

DIRECTORY OF CERTIFICATES & AWARDS. ONLY one in world. World's amateur and SWL achievement awards and how to get them, $2.50. Clif Evans K6BX, Box 385, Bonita, Calif.

UNIVERSALLY ADAPTABLE ECONOMY QSL cards & Eye-Ball QSO cards. 100 for $1. 200 for $1.85. Postpaid. Clif Evans K6BX, Box 385, Bonita, Calif.

DIRECTORY EXTRA Newsletter, quarterly. FREE PRESS news of world Amateur affairs. CHC & FHC & SWL-CHC news. Over 2000 DX QSL Manager listings. $2 a year. Clif Evans K6BX, Box 385, Bonita, Calif.

HEATH SENECA 6-2 METERS with modulator al $165.00. 720 Eico Transmitter with Crystals $75.00 WA4HYA. Earl Wood, 120 Noble Ave., N. E. Roanoke, Virginia 24012.

DYNA-PAK—completely transistorized unit; used as signa generator. voltage monitor, continuity tester, code oscil lator, code monitor and other uses. $2.98 Deltronic Labs Box 128, Horsham, Pa.

PRINTED CIRCUIT KIT—complete; two copper cla boards 2¾ X 5, etch tray, etchant, etching resist, layou grids, cleaning pad, instructions. $2.98 Deltronic Labs Box 128, Horsham, Pa.

QSL's $1.75/100. Eye-catching, different. Sparkling gol or silver printed on six exciting Hi-Gloss cardstock color Samples 5c. Nu-Print, Dept. A. 322 Page Boulevar Springfield, Mass.

DUMMY LOAD, 50 ohms. All bands up to legal limi Size, 3 x 4 x 7. Coax connector. Kit $7.75, wired $9.75 p Ham Kits. Bx 175, Cranford, N. J.

COMPLETE SHACK—National NC-98 rcvr, Vm Viking II, Heath Kit VF-1, VFO, Pre-Selector RMI DB-23, Speech Clipper RME, Q-Multi, like new, operation $325.00 W2JGQ Isaacs 231 East 11th S N. Y. 3.

COLUMBUS ARC HAMFEST. Columbus, Ga. Mar 28, 1965. Contact K4UYC for more information.

ORLANDO ARC HAMFEST at the Cherry Plaza Hot April 23-25. Displays, tech talks, swap shop, Sat. nig dance. Contact Betty Kuller WA4JIU, 401 Halsey S Orlando, Fla.

PLATE TRANSFORMERS for that solid state pow supply. 690 v at 450 ma. No CT. 117 v primary. He matically sealed. 19 lbs. $3.95 plus postage. ARC Sal P. O. Box 12, Worthington, Ohio.

75S-3, 312B-3, 32S-3, 516F-2, 30L-1. All mint conditi at $1650. Will ship prepaid. WA5BAU, 7424 Edwin N.I Albuquerque, N. M.

QRT COLLECTING; Selling antique wireless items and other stuff. What do you want? Free lists. Send large stamped addressed envelope. W6LM. P. O. Box 308, Wrightwood, Cal.

HEATH SWEEP GENERATOR TS-2, $26. Dumont 241 Scope, $65. Globe Hibander 6 and 2 meters, $1.95. Gonset Communicator I, 2 meters, $105. Heath HG10 VFO, $25. W2FNT, 18 Hillcrest Terrace, Linden, N. J.

WANTED: Hallicrafters S-51 receiver, covering 132 kc to 13 mc. Describe condition fully, stating price. Peter Spiliotis, 6 Brentwood Circle, Danvers, Mass.

SOUTHERN TIER ARC DINNER, April 3, 1965, 7 pm, St. John's Ukrainian Hall, Johnson City, N. Y. For tick-ets, contact W2SDA, 1165 Vestal Avenue, Binghamton, N. Y.

FREE! BLUE BOOK LIST. Leo offers hundreds of bargains on reconditioned gear. Viking II $97.70; NC300 $189.00; Collins 62S-1 $625.50; King 500A $259.00; SP600 $296.65; HT-37 $254.15; DX-40 $40.50; Cheyenne $49.18; CE-10B $69.00; SX-101 $160.65; PRO310 $299.00. Many more, also free 1965 catalog. WØGFQ, WRL, Box 919, Council Bluffs, Iowa.

ELDICO SSB 100F. Very stable $300. Joystick antenna and tuner $15. 6N2 converter $30. LP filter $5. Kreco 0 M coax vertical, unpacked $25. FOB. R. Lamb, 1219 Yardley Rd., Morrisville, Pa.

CONVERTERS $10 and up. World's largest selection of frequencies. Ham TV vidicon cameras and parts at low factory-direct prices. See them all now in our full page ad in this issue. Vanguard Labs, 190-48 99th Ave., Hollis, N. Y. 11423.

DIRECTIONAL COUPLERS, identical to M. C. Jones, Model 500. Coupler and meter new! $15.50 post-paid. Jim Morgan 3693 Section Road, Cincinnati, Ohio 45237.

SWAN 240—For sale, excellent condition, with HB ac supply, Turner ceramic mike, $225. Transceiver alone available $200 fob. K1SCC, Boulder Circle, Glastonbury, Connecticut.

ENGRAVED PLASTIC 7" x 3" signs—first name and call—black, walnut, mahogany, with base $3.00. Pinbadges ½" x ¾"—black or blue—first name and call $1.00. I & M ENGRAVING—P. O. Box 2143 Culver City, Calif.

TELETYPE RIBBON modification kit for Model 15. Few surplus. Nylon ribbon automatically re-inks, outlasts 50 ordinary ribbons. $4.95, postpaid. Telemethods, 3075 E. 123rd, Cleveland, Ohio 44120.

TELETYPE TEST SET I-193C, Government surplus. Generates perfect 22 millisecond pulses (60 wpm) for adjusting RTTY transmitters, repeaters, converters, etc., for zero bias. Also tests and adjusts polar relays. Complete with tool kit, manuals, four polar relays. Brand new. $24.95, F.O.B. Harrisburg, Pa. Telemethods, 3075 E. 123rd Street, Cleveland, Ohio 44120.

432 THE EASY WAY. Nuvistor superreg receiver-tuner for 432 mc. Add any audio amplifier for exciting listening. Tested and guaranteed. $12.90. UHF, 5111 Genesee St., Buffalo, N. Y., 14225.

NEW RDR 235 to 395 MC RECEIVER. 15 tubes, built-in 12 volt power supply, 155 page manual, $25. Manual only, $4. Conversion Aug '62 73. Precision Tuning Fork, 400 cy., $10. Polar Relay, $2. 30 Miniature Relay Circuit Board, $8. Bauer Industrial Supply Co., 7170 Redford, Detroit, Mich.

SPECIAL on single hole chassis mount UHF coax connectors with screw-on hood for either RG/8 or RG/58. Specify which. $.49 each or three for $1.30. Postpaid. A.R.C. Sales, P.O. Box 12, Worthington, Ohio. No COD's. USA only.

THE BEST WAY TO BUY SURPLUS:

Ask for what you need. We will then send you COMPREHENSIVE DATA on what we have to meet your needs. DON'T ask for a catalog . . . it would take a fat book . . . and then it would give you less details about the thing you are interested in than we will give you in answer to your letter. Be as specific as possible as to frequency, power needed, etc.

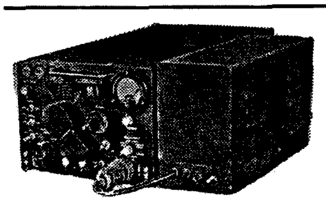
For example, we have THIRTY DIFFERENT MODELS of calibrated-output laboratory-grade Signal Generators ranging from 10 kc to 21,000 mc, and some with power outputs over 10 watts for R.F.I. work, etc. Some FM, some PM, some CW and/or AM.

We have Meters, VTVM's, Bridges, Galvos, Voltage Dividers DC and AC, Digital Voltmeters DC and AC, Counters, Pulse Generators and Delay Systems, other Frequency Meters than those mentioned above, wide variety of Regulated Power Supplies, Line Voltage Regulators from ½ to 10 KVA, Tektronix and other Oscilloscopes, scope Cameras, many types of Graphic Recorders, Spectrum Analyzers, Teletype, Tuning-Fork-controlled Oscillators, Direction Finders, FM Ground Station, Tube Testers, Noise & Field Strength Meters, Ultrasonic generators and test gear, Aeronautical Radio Test Gear, etc. etc. and etc. . . . and we KEEP BUYING NEW MATERIAL ALL THE TIME! Just got in some laboratory Calorimeters, a few Magnetometers, a high-vacuum pump, and even a shipboard Rangefinder and two complete Submarine Periscopes! Much material is here today and gone tomorrow, but we keep a lists of WANTS and will notify you if the item you need gets acquired.

We DON'T sell mdse the way we get it in just to be able to advertise at a price lower than someone else's. We work it over . . . test it . . . overhaul and calibrate it . . . and GUARANTEE SATISFACTION OR MONEY REFUNDED!

WE ALSO BUY so if you have anything to sell, tell us about it and how much you want for it. When we answer your inquiries and describe material we are offering, we also price it. . . . You wouldn't think very much of us if we asked you to make us an offer!

BROADCAST-BAND COMMAND RECEIVER: ARC Type 12, No. R-22. Late type! 540-1600 kc, 6 tubes: RF, converter, 2 IF's & AVC, det. & Noise Limiter, & AF. 2 uv sensit. Needs external pwr sply & control ckts & has no tuning dial. With spline tuning knob, chart to turn exact freq. by turns count, lots of tech data, OK grtd. **17.95**
(Add $3 for extra-clean selected unit.)



ALL-BAND SSB RCVR BARGAIN: Hallicrafters R-45/ARR-7. 550 kc to 43 mc continuous: Voice, CW, MCW: 2 RF's. 2 IF's: S-meter: 455 kc Xtl. 6 select. choices. Ready to use. w/60 cy pwr sply & book aligned. fob Los Angeles **199.50**

Deduct $30 if you make your own pwr sply from schematic we furnish. Deduct $20 if SSB not required, or deduct $15 if you will wire in your own SSB with kit & diagram we furnish.

TIME PAY PLAN: Any purchase totaling $160.00 or more, down payment only **10%**

ARC-5 0-5'er Rcvr 190-550 kc w/85 kc IF's. Use as 2nd converter for above or other rcvrs. Checked electrically. w/lots of tech. data. w/spline knob. 9 lbs. fob Los Ang. **14.95**
(Add $3 for extra-clean selected unit.)

AC PWR for SCR-522: RA-62-B made by Signal Corps for the specific job! 115/230v, 40 60 cy in. Regul. & filt. outputs 300v, .26A; 13v, 4A; -150v. 10 ma. OK grtd, w/data, 90 lbs. fob Sacramento **29.95**

AN/APR-4 RECEIVING UNIT w/tuning units to tune 38-1000 mc plug & handbook. all checked & grtd 100% OK, ready to use on 60 cy **179.50**

Add $30 for am/fm version modified for 60 cy pwr input: add $60 for TN-19, 975-2200 mc; add $125 for TN-54, 2175-4000 mc. All uncond. grtd. OK.

LM FREQ METER 125 kc to 20 mc is combin. heter. freq. meter & signal source. CW or AM, accuracy .01%. xtl calib. Clean, checked 100% grtd. w/plug, data. 16 lbs fob L A **57.50**

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73 Amateur Radio

May 1965
It may be 40c.

RM-499 Released!

Log Periodics 432 Converter Versatile Scope
Beer Can Converter 1215'er 5000 Watt Linear!

73

Magazine

Wayne Green W2NSD/1
Editor & Publisher

Paul Franson WA1CCH
Assistant Editor

May, 1965

Vol. XXXI, No. 1

Cover by Barry Ober K2YDD

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de W2NSD/1

never say die

They Laughed

Yet, they laughed and sneered when I said, "FCC Docket Due in March." On March 31st the FCC dropped the bomb. I laughed back. Here is the FCC synopsis of the proposal . . . you can read the whole dreary text in QST, if you want, it won't get you anything over this:

FEDERAL COMMUNICATIONS COMMISSION

65821
PUBLIC NOTICE-S
March 31, 1965

WASHINGTON, D. C. 20554
Report No. 1851

NONBROADCAST AND GENERAL ACTION

The Commission en banc, by Commissioners Henry (Chairman), Hyde, Bartley, Lee and Cox took the following action on March 31:

INCENTIVE LICENSING AND DISTINCTIVE CALL SIGNS PROPOSED FOR AMATEUR RADIO SERVICE

The Commission proposed amending the Amateur Radio Service rules to provide a new "Amateur First Class" operator license with reservation of the lower half of the 3.8, 7.2, 14.2 and 21.25 Mc telephony sub-bands, and 50.00-50.25, 144-145 Mc to Extra and First Class operators only. Reservation of the lower 50 kilocycles of the 3.5, 7, 14 and 21 Mc bands for Extra Class telegraphy operation is also proposed. The lower half of each segment would become reserved in 12 months, with full reservation 2 years after adoption of the proposed rules.

The First Class examination would require a 16-word-per-minute code test and a written examination intermediate in level between the General and Extra Class examinations. Eligibility would be limited to applicants who have held an Advanced, General or Conditional Class license for at least a year.

Except for a proposed elimination of Novice telephony privileges in the 145-147 Mc band, all classes of licensees would continue to have telegraphy and telephony operating privileges in a portion of each band in which they now have such privileges. Because a valid distinction between them no longer exists, Advanced Class licenses would be changed to General Class upon any renewal.

A distinctive call sign assignment procedure is proposed. The stations of Extra and First Class licensees would be assigned "two-letter" calls (two letters following the number). Unassigned two-letter calls with a single letter prefix would go to the old timers of these classes who were licensed prior to July 1, 1932. Conditional and Technician licensees would be assigned a distinctive two-letter prefix as has been the case for Novice Class licensees. The "one-by-three" combination would be reserved for the Advanced/General Class group.

This action constitutes the Commission's proposed action on petitions RM-378, 455, 470, 474, 480, 481, 499, 516, 517, 538 and 577.

Comments of interested parties may be filed by July 15 and replies by July 30.

Riot, eh?

When I first read it I was surprised at how closely this proposal follows RM-577, my own entry in the incentive licensing derby. You can go back and research my submission if you like and see the strong parallel, I won't belabor you with it. After looking over all of the ideas brought up on the incentive licensing deal I sorted out those that seemed most practical to me and presented them in a package to the FCC.

The resulting plan, Docket 15928 (they could have given us a lot better number than *that*), successfully answers most of the criticisms leveled against ARRL's RM-499. Most important of all it does not throw anyone off any bands.

My first reaction to 15298 was one of relief . . . it wasn't as bad as it could have been. Then I got thinking about what this was supposed to accomplish . . . and what it might accomplish. Rather than my carrying on at length this month with my views, why don't you talk this one over . . . and even more important . . . think it over and see what you decide about the thing. Carefully consider what value the three wpm code speed increase will have . . . and what drawbacks there are to it. Also consider the pros and cons of the First Class license. Ponder too the impact on ham radio as we know it of the splitting of the bands . . . the new call signs . . . consider each band separately . . . the effect on contests, DXing, rag chewing, six meters, two meters, etc. Will these changes be beneficial enough to be worth the immense cost to the FCC in assigning us all new call signs and stepping up their monitoring program to keep up without further divided up bands, not to mention the one to two million dollars in new license fees we will have to pay . . . the effect on older hams who are leading busy professional lives and may be discouraged at having to learn a new license test all over again to keep in touch with

heir old buddies . . . the great problems housands of us have in merely getting to an 'CC licensing point now that the Conditional .icense is virtually a memory.

Think it all over and send your thoughts n as soon as you can so I can run them in he June issue. I'll try to sort out the most well hought out letters. Letters received here be- ore April 30th will be considered for June nd those up to May 30th for our July VHF ssue.

Perhaps, in view of the 16 wpm bit, it is ime to discuss the value of CW ability today . . 1965.

July 4th

Ever since our open house back in August 962 I've been wanting to get more of you p here for a personal visit and to get you to ee New Hampshire. The big day is July 4th. f you can manage it please come on up and oin us for a New England Hamfest. We're rying to think of everything possible to make his an outstanding time.

Bring any ham gear you want to sell . . . ve'll have a big auction going all day long . . . t least as long as the gear holds out. We'll be enting the local armory here so we'll have ots of space for exhibits by manufacturers and ealers. Bring a picnic lunch or plan on nacking at any of the nearby restaurants . . . here is one right across the street from the rmory.

We'll be set up for field strength measure- ents on both 144 mc and 432 mc, so bring e best antenna you can hold by yourself nd see if you can win the prize for the best eld strength. We will have a real professional etup to test the antennas . . . here's your hance to see how good yours really is.

Since 73 is largely devoted to homebrewing ear we'll have prizes for the best home con- :ructed equipment . . . bring as many entries s you want.

We'll also have tours of the 37 room head- uarters building and the 73 Mountain VHF nack. We want you to see as much of New [ampshire as possible too so we'll have spe- ial maps available which show the major laces of interest in the state. And, as I may ave mentioned before, New Hampshire is one f the most beautiful states in the union . . . nd it is small enough so you can easily drive ver much of it in one day. If you drive up om New York, New Jersey, Pennsylvania, tc., on Saturday you will be able to visit ower New Hampshire that same day. Sunday our hamfest. On Monday (a holiday) you an go up through the White Mountains, up the Tramway, the Flume, and Mt. Washington, and back home again that night or the next morning. We're only a little over four hours by car from New York City here.

If you think you are coming you might drop us a card and let us know so we can plan things for the size group we'll have. Also, if you will be wanting reservations to stay over- night in the area we can help with that too . . . but please don't wait too long for New Hampshire is buzzing at this time of year and reservations can be hard to come by.

If you have mobile VHF gear you can give it a good workout from nearby Pack Monadnock . . . you can drive right to the top. Mt. Monadnock (73 Mountain) is avail- able for easy climbing if you dig that stuff.

Do figure on coming up for a hello and a good time on the 4th.

Hamfest?

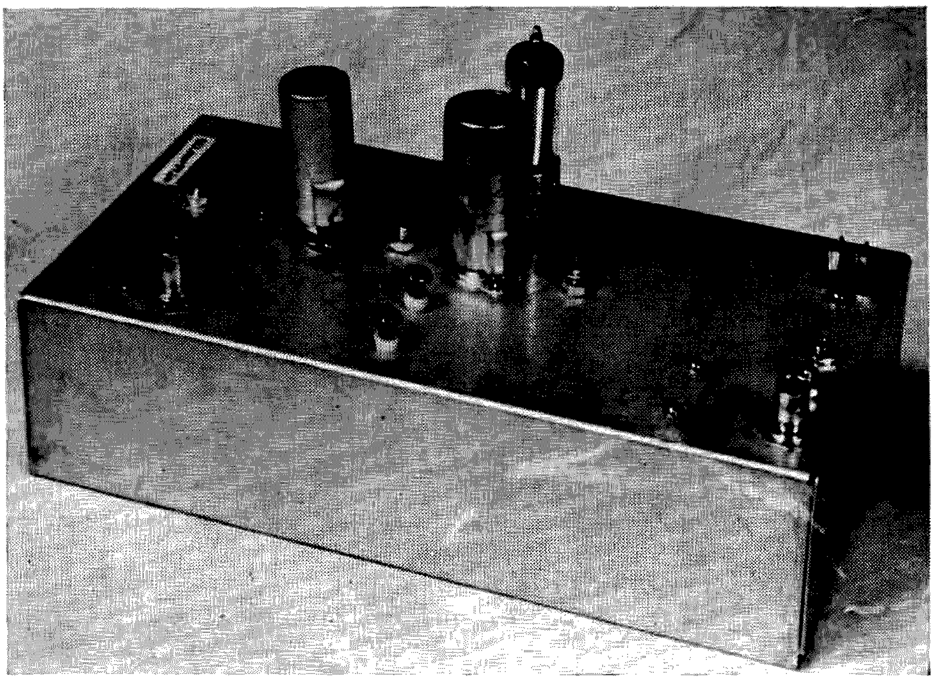
Paul and I took in the IEEE show and SSB Hamfest this year. Though I was disappointed that they made room for CQ to have a booth, while having no room for 73 . . . it was all for the good. CQ did a rousing business in en- graved badges and I got to talk to about 1000 friends. Peggy Browning was there, fresh from her visit to Bhutan. Dannals was there, but didn't notice me. Huntoon waved hello. A couple of the manufacturers who have been pointedly not advertising in 73 smiled cryp- tically. And quite a few fellows bent my ear, filling me in on recent ARRL misdemeanors and other trivia of ham life.

We also took the opportunity to stuff on interesting foods: Japanese, Chinese, Lebonese, and Viennese. Say, if you are ever looking for one of the nicest, friendliest restaurants in New York, you might visit the Konditorei, 33 Irving Place . . . regards from Wayne. Stop in for some coffee and Viennese pastry some night, at least.

Ham Stamp Wins Award

"Sour Grapes," they said . . . accusing me of being critical of the ham stamp just because it was designed by the ARRL. Well 30,249 votes were counted in the 17th Annual De- sign Derby for the best and worst design of U. S. commemorative stamps. Of the 18 dif- ferent commemoratives issued in 1964 our blessed ham stamp got the fewest votes for "Best Design." Not content with giving us the booby prize, the poll also asked for votes for the worst design of the year. We only won second prize in that category . . . being dis- placed by the Fine Arts stamp. Perhaps we

Continued on p. 100



Jim Kennedy K6MI
2816 E. Norwich
Fresno, California

432 mc Converter

The recent increase in interest in 432 mc has sent many a budding UHF enthusiast scurrying to the various handbooks in search of a good converter circuit.

A number of such circuits will be found. However most suffer from circuit complexity. Tube mixers are expensive if they are to be effective. Multiplier chains are often long and somewhat ungainly. In addition, when you have finally built your basic converter, you will still have to add a hot RF preamp to get the most from your receiving system. All these factors can cause even the most enthusiastic ham to pause and count his pennies.

One approach to the problem would be to assume that the converter will be used with a good preamp, at least for long haul work. This will give a much greater latitude to the design of the basic converter.

Noise figure is, within limits, of little importance. In fact, in the interest of economy, no special effort should be made to make the noise figure any lower than that maximum value which the preamp has sufficient gain to cover comfortably. There is no point in paying out good money and time to build an 8 db converter if you intend to put a 5.5 db preamp with 15 db plus gain in front of it. At the same time there is not too much point in building 8 db converter and no preamp, when a 5.5 d or better preamp can be had for about tl same extra cost.

This relaxation of the noise figure requir ment makes an inexpensive crystal mixer loc very attractive.

The injection chain can be simplified b starting off with an overtone crystal in the 4 mc region. This is a fairly common practice i VHF converters. A crystal in the 60 mc regio would eliminate an additional stage of mult plication and reduce the tube compliment b one, but the crystals in this region are mor expensive and the frequency stability of th converter may suffer.

The number of tube stages can be furthe reduced by making use of a simple diod multiplier for the final multiplication.

This leaves three tube multiplier stages re quired. They can easily be accommodated i two tube envelopes.

The choice of *if* frequency often depends o the receiving frequencies available, but in th interests of image response an rf to *if* ratio o about 10 to 1 is recommended. This makes meters a logical choice.

Using 6 meters as an *if* has an added div

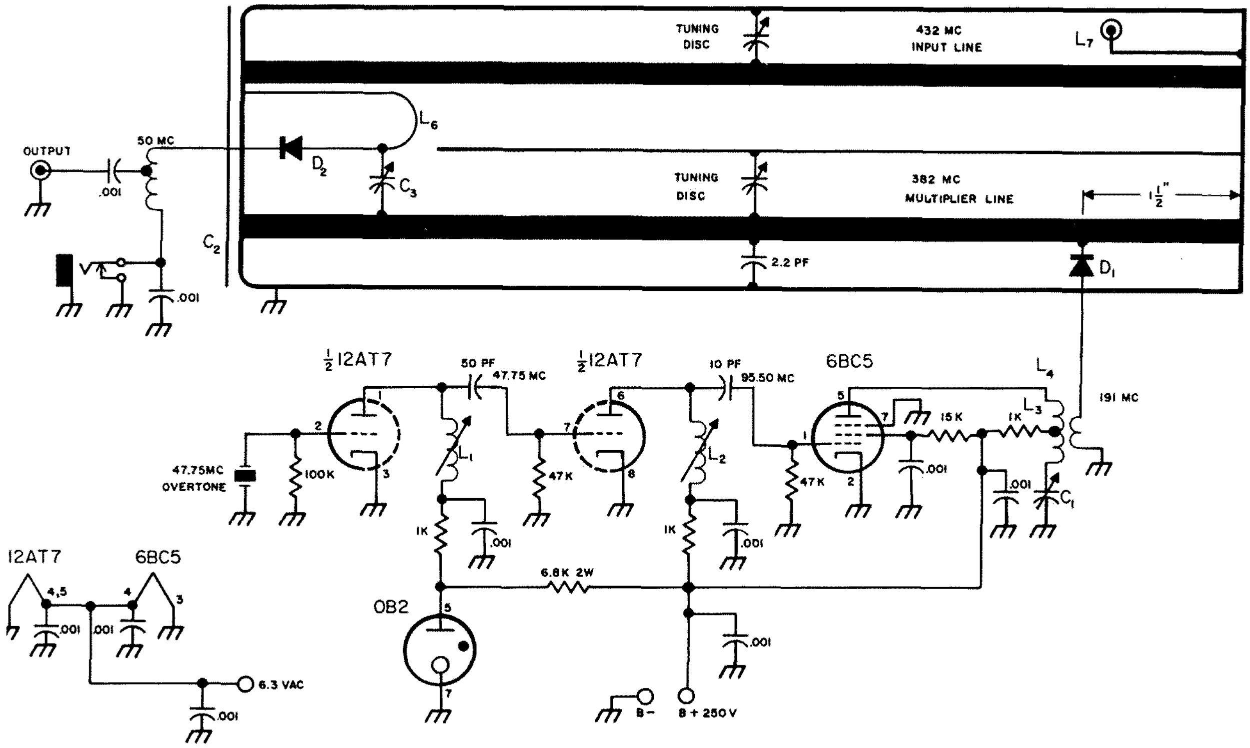


Fig. 1. 432 mc converter.

. 1-5 pf plastic trimmer.
. UHF bypass. See text.
. Injection coupling. See text.
L2. Slug tuned to frequency.
10 turns #19 enameled ¼ in. dia., CT.
3 turns #18 enameled, ¼ in. dia.
L5. Slug tuned to *if* frequency. Tapped fairly high.
L6. Mixer coupling. 2½ in. total length, ¼ in. wide.
L7. Input coupling. 1½ in. total length, ¼ in. wide.
D1. 1N72 or 1N82.
D2. 1N21C.

ınd. Most 6 meter converters are equipped ꞏh a high gain low noise rf amplifier. This ındance of gain will make the *if* amplifier ɜd in conjunction with most diode mixers ite unnecessary. In most cases this eliminates ɔther stage from the 432 mc converter.

Construction

The diode mixer and multiplier circuits are o adjacent trough lines. The multiplier line d to be lengthened somewhat by additional ɔacitive loading to fit the chassis size used. e lines were made from 16 gauge brass ɜet stock and ¼ inch brass tubing. The vari- s coupling loops are made of strips of .003 ꞏh brass shim stock about ¼ inch wide. The rious dimensions of the lines are given in gs. 1 and 2.

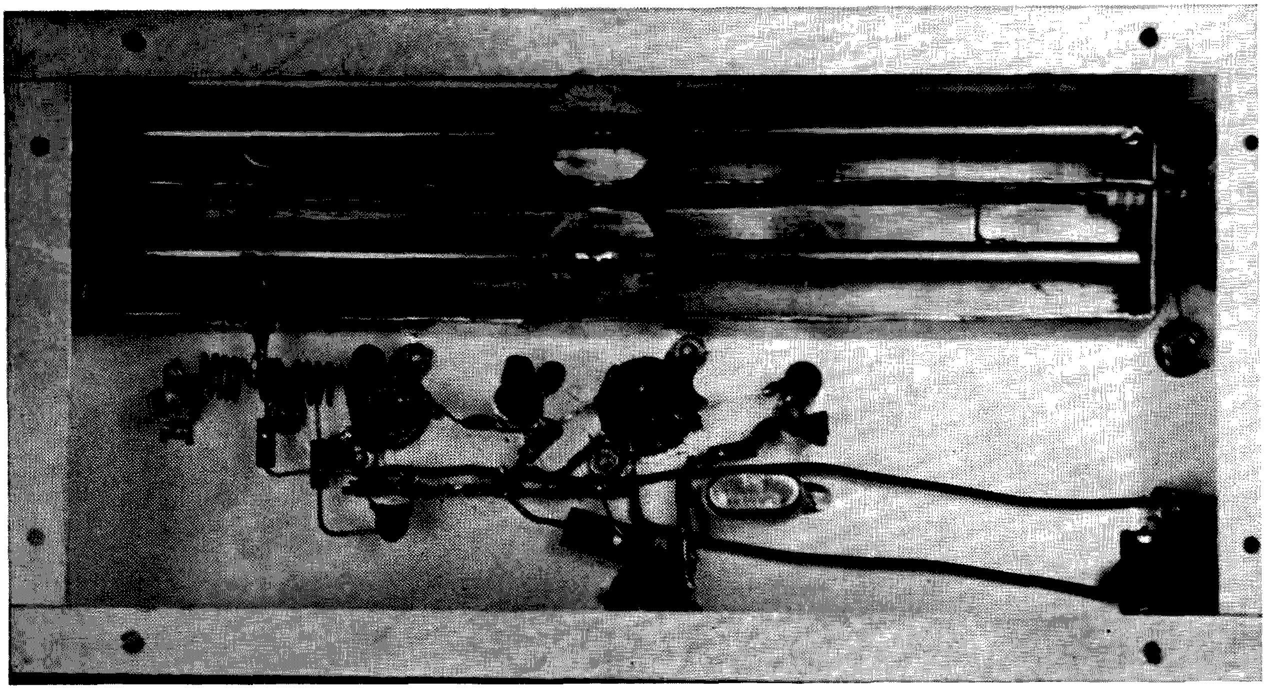
Both lines are tuned with variable capac- s constructed of brass discs about ⅝ inches diameter. The discs are soldered to the in- e center of each line. The other capacitor cs are soldered to the ends of 10-32 screws ıich are mounted through tapped holes in ɜ trough box or by a 10-32 nut soldered to ɜ box.

The mixer diode is mounted on a ¾ inch by 1¾ inch plate of brass shim stock. A hole is drilled in the center of the stock to just clear the ceramic and brass portion of the diode body (but not the brass lip on the large end). Then a 3/16 inch piece of 9/32 inch diameter brass tubing is soldered over the hole. The end of the tubing can be deformed slightly or you may cut slots in it to form fingers which will hold the diode firmly in place.

The mounting plate for the crystal is insulated from the line box for dc by a thin sheet of teflon or mylar tape. This is held in place by two nylon screws or insulated metal screws. This assembly acts as a bypass capacitor for the UHF signals but acts as part of the tuned circuit for the 50 mc signal and has no ill effect on it.

The clip for the small end of the crystal is made by bending the end of the ¼ inch wide diode coupling loop into a triangular shape with a pair of pliers. The small tip on the diode then fits into the clip.

The injection coupling capacitor is a shim stock tab attached to the multiplier line and



Bottom view. Note that input loop is obscured by inner conductor.

brought near the mixer diode loop. Varying the spacing between the tab and the loop will vary the injection coupling.

I have found it convenient when working with such circuits to build the trough lines as a complete sub-assembly, that is, with BNC fittings and other protrusions attached to the trough directly rather than to the trough *through* the chassis. The chassis holes are then drilled out to pass the entire fitting. In this way, the entire unit may be assembled and tested free of the confines of the chassis itself.

Parts layout for the injection chain is not too critical, though it would be well to remember that frequencies up to about 200 mc are involved. Bypass capacitors should be used liberally on B+ and filament circuits. A symmetrical layout which will end with the multiplier diode near the appropriate point on the trough line should be used.

Some experiments were performed in an effort to see if the diode could provide enough mixer drive quadrupling rather than doubling. This would eliminate the need for the last tube multiplier. It was found that the diodes used would provide only enough mixer current to provide marginal operation of the converter, even with the 12AT7 going full blast on 250 vdc.

On the other hand, the circuit should in Fig. 1, which uses the additional tube multiplier, develops more than sufficient drive even at low supply voltages (over 900 microamps with 90 vdc).

As a result, this configuration seems m adequate. If a more exotic diode had be used in the multiplier, the quadrupling a rangement could probably be made to wo out. A varactor like the DR-303 would u doubtedly outperform the 1N82's and 1N7 in such a configuration.

The use of the VR tube on the oscillator not mandatory, but it is highly recommend to maintain the stability of the converter wh confronted by line voltage variations. Moun ing the crystal below the chassis also improv the stability by protecting the crystal fro drafts and other such sudden temperatu changes.

Tune up

Preliminary peaking of injection chain c be easily accomplished with an absorbti meter. An alternate method would be to tu for maximum multiplier diode current. B member that it is sometimes possible to bu out 1N72's and 1N82's with the rf availab from the injection string if they are coupl too tightly.

Once the tube stages are peaked, coup the diode multiplier line output tightly i the mixer diode. The mixer diode curre should then be peaked by tuning the dio multiplier line. It should be possible to obt up to 2 ma of mixer current depending mixer coupling and diode multiplier inp coupling.

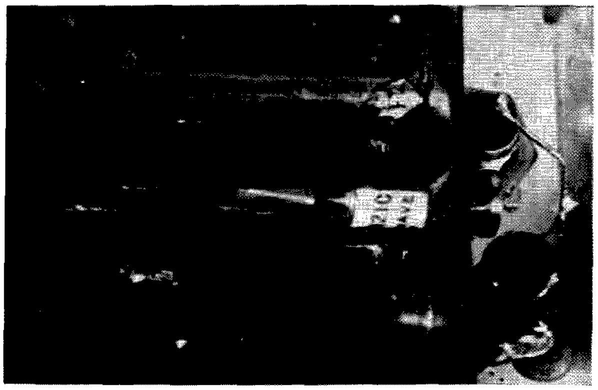
Some care should be exercised in the choi of meter used in measuring mixer curre

.ny of the VOM's on the market today em-
›y a 500 ua or less basic meter. It will be
ınd that, in most cases, the internal resis-
.ce of such meters is rather high. If this is
it will produce some very confusing read-
;s when used to measure the diode current.
e impedance of the 1N21 series diodes is in
: general neighborhood of 300 ohms. If the
ıter has, for instance, an internal resistance
300 ohms, then the measured current will
only one half the true current when the
ter is removed, because the meter and
ıde are in series.

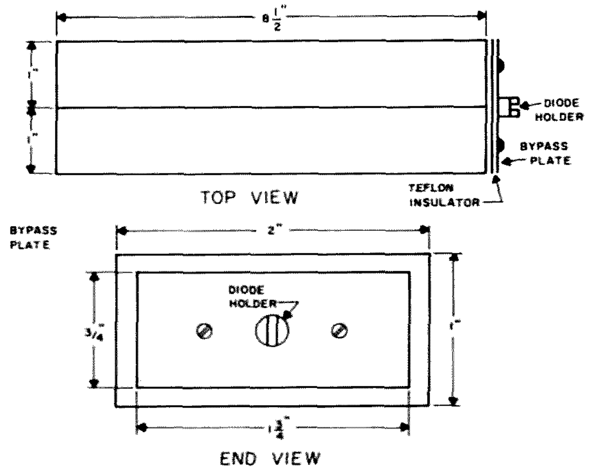
Rather than use the VOM, a better choice
ıuld be to use a low internal resistance 0-1
\ meter. Many such meters with internal
istances of about 50 ohms, are available on
: surplus market for reasonable prices.

[n normal operation only about 500 micro-
ps of mixer current will be required. Once
: proper operation of the diode multiplier
; been confirmed, the multiplier input and
:put couplings should be reduced until a
ker current of perhaps 600 or 700 micro-
ps is realized. The final adjustment of the
·stal current can be made conveniently by
:uning one of the tube multiplier slugs (not
: oscillator) or by adding a screen pot on
: 6CB6.

The diode multiplier coupling reduction is
/erned by three considerations. First, the
ıltiplier diode current should be kept below
: burnout point, so a reduction of input
ıpling will provide extra safety margin in
s respect. Second, it is desirable that the
ıpling between the input cavity and the
ıltiplier cavity should be kept at a minimum
avoid signal loss to the multiplier line. If
: 50 mc *if* is used this problem is minimized
:ause of the separation of the resonate fre-
encies of the two cavities. However, if some
ıer lower *if* is used this becomes increas-
;ly more important.



Mixer assembly. Note coupling loop and injection capacitor tab.



TROUGH LINE BOX DETAILS
(INNER CONDUCTOR REMOVED)

Fig. 2

The two above considerations should be balanced against the importance of delivering sufficient excitation to the mixer diode.

As noted, if the *if* is low enough, some signal will be lost because energy is coupled into the multiplier line. This same effect will also occur in the reverse: injection energy can be lost by coupling into the signal line (and then into the antenna) when the signal line is tuned through the injection frequency. This effect will be indicated by a severe dip in mixer current.

This phenomenon can provide a convenient frequency reference. If your injection is below the desired signal frequency then you should tune your signal line to the high frequency side of the mixer current dip.

The final tune up requires a weak signal source. Either a test signal generator or an on the air signal will do. Connect the converter output to the input of the 50 mc converter. The signal line should be tuned for maximum output. Then tune the *if* output coil for maximum.

You should find that when the signal is removed, the mixer noise can be peaked with the *if* coil. If not, then the *if* coil may not be resonate or the output tap may require adjustment. It may also mean your *if* amplifier (50 mc rf amp) is not sufficient, though the average six meter converter should do quite well.

Every mixer diode has some value of mixer current at which it will produce the best noise figure and hence the best results.

If a noise generator is available it can be used for the adjustments. If not, the signal to noise ratio check should be used.

The procedure is simple. Starting with a mixer current around 700 microamps the current should be reduced in small increments

(about 50 microamps) and the noise figure or signal to noise ratio observed. At some point, probably above 250 microamps, the noise figure will be at a minimum and the signal to noise ratio maximum.

It would be well to point out that the signal strength will increase with mixer current. However, the noise will increase likewise. Therefore, signal to noise ratio, *not* signal strength, should be the only criterion for judgement.

Results

The final result of all this tuning and pruning should be well worth while. The mixer diode used was a 1N21C which is available very inexpensively both new and surplus.

The noise figure of this converter is in the neighborhood of 14 db. This is not outstanding, but is in keeping with the original premise that the noise figure of the basic converter is of only secondary importance.

This noise figure is low enough to cover quite easily with any of the better rf preamps.

The 416 B preamp described in an earlier article[1] does an excellent job, as do some of the better nuvistor and transistor preamps. Needless to say, a good paramp will outperform them all.

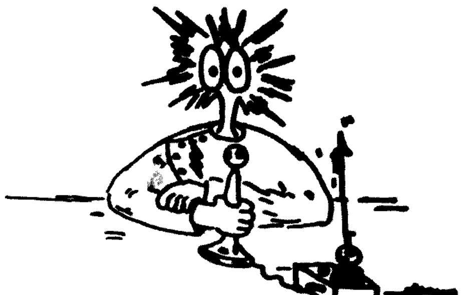
For those who feel they need a low noise figure in the basic converter, a more expensive mixer crystal would be a good start. The 1N21E sells for about $5.00 and the 1N21F for about $15.00.

Experimenting with the mixer loop size or the loop size on the input line would also be likely to produce some improvement. As previously stated, however the extra money and effort would probably be better spent on a hot front end preamp.

. . . K6MIO

Pictures by Joe De Young WA6CQL

1. 432 mc Preamplifier, Low Noise. 73 October 1964.



"Of course I'm interested in earth-bounce, Torfl. . . . But what can I hope to accomplish with this dinky lil' ole homebrew mega-watt rig?"

Paul Schmidt W9ID
P. O. Box 2
Bloomfield, Ind.

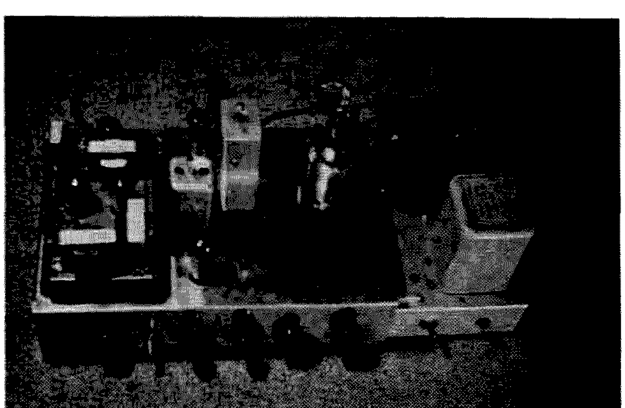
A New Approach to Phasing

This is not a blueprint for an exciter but rather, a collection of design ideas about phasing type SSB. You CAN design and build your own sideband equipment which will produce every bit as high quality signals as the store-bought kind. It may take a little time, but it saves cash and creates pride.

Glancing quickly at the basics of SSB, you will see that a balanced modulator is the heart of all single and double sideband exciters. The filter approach to SSB requires only a single balanced modulator, while the phasing method requires a dual arrangement.

The balanced modulator is the stage of the exciter in which an rf carrier (preferably not operating on the transmitted frequency) combines with the audio signal to produce sidebands minus carrier. It should be kept in mind that sideband is a type of AM, so don't be too rough on your Ancient Modulation friends. AM is referred to as A3 emission; SSB is A3j.

Have a look at the filter type exciters. They generate SSB on one frequency, usually crystal controlled, and heterodyne up or down to the operating frequency. This calls for a mixer stage following the balanced modulator. This is also good practice for the phasing exciters. A separate injection frequency provides much greater long-term stability to the rf phasing and the carrier nulling.



Top view of transmitter.

In building any exciter, filter or phasin type, there must be incorporated some speci component. In the filter rig it's a mechanic or piezo crystal filter; in the phasing rig the is an R-C ninety-degree audio phase shift ne work.

The 90° audio phasing system about to b described was designed around the conce of using only standard off-the-shelf comp nents. The results are extremely gratifyin Unwanted sideband rejection is ideal. Aud quality is good, comparable to the best on th market. The balanced modulator stays tune up and nulled out for months of operation.

Before describing the phasing system, would like to discuss the balanced modulat used with it. Fig. 1 illustrates a phasing ty dual balanced modulator. Instead of using tl expensive sheet beam tubes, this applicati calls for two economical dual pentode T synch separator tubes, 6BU8's. The transform windings L_1 and L_2 consist of pruned prima and secondary of an air core 455-kc *if* tran former, rewired as shown, and operating o 900 kc. The secondary, L_3, is about 150 tur

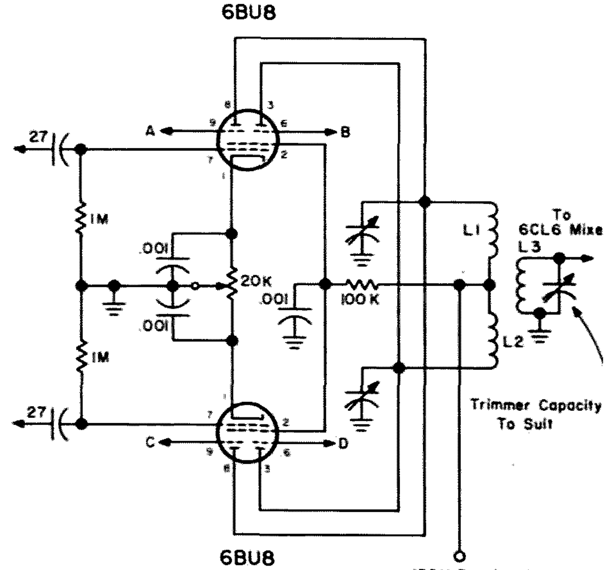


Fig. 1. 6BU8 dual balanced modulator

Fig. 2a
The usual audio phaser

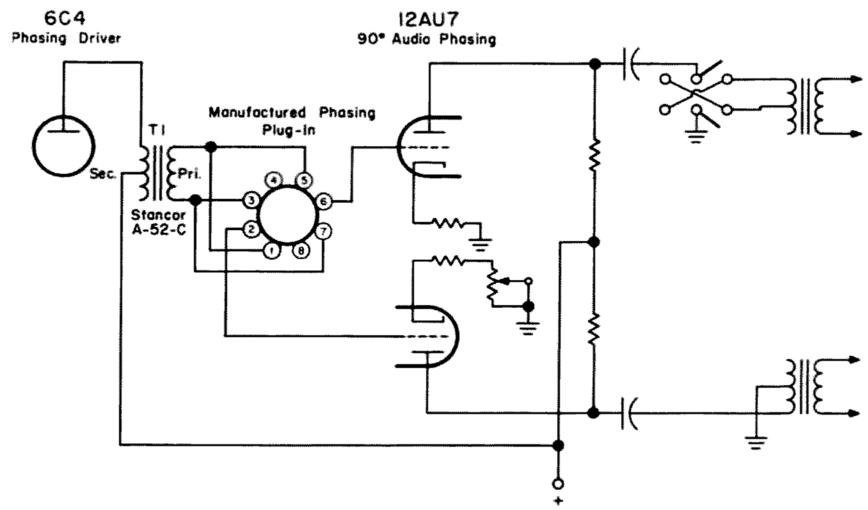
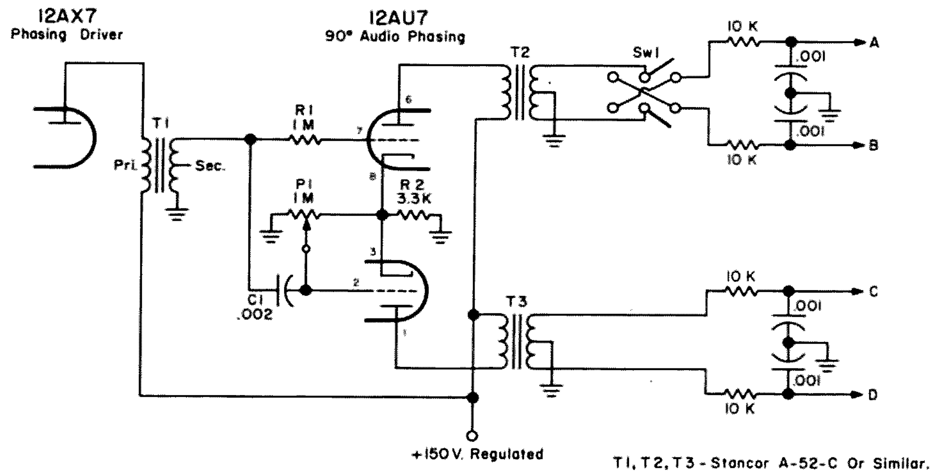


Fig. 2b
The Schmidt phaser

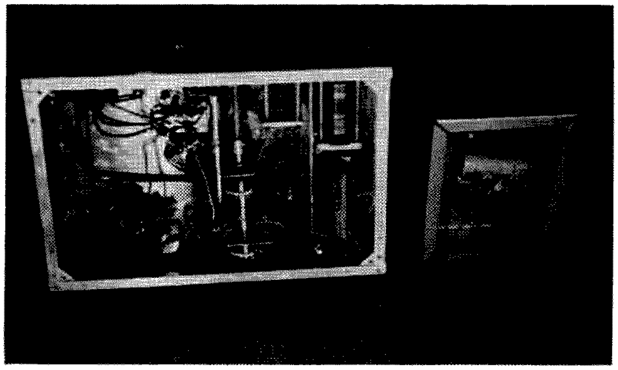


cramble wound Litz wire on the ½" diameter orm between L_1 and L_2. Ninety-degree phased ıudio is brought to the suppressor grids hrough leads A, B, C, and D.

Fig. 2-a is an audio phase shifter for driving ı type of dual balanced modulator.* It uses a nanufactured plug-in R-C 90° audio phase hift network. Fig. 2-b is the author's original)0° audio phase shifter for driving the balınced modulator of Fig. 1. It is called the 5chmidt phaser (with due respect to the originator of the Schmitt trigger). Note that both)hase shifters are triode driven and employ ransformer coupling in and out. In both)hase shifters T_2 and T_3 should be the same ype, but do not have to be a matched pair. \ny single plate to push-pull grid type transormers should work. T_1, the Schmidt phaser nput transformer should be a single plate to ;ingle or push-pull grid interstage type. The nic. preamp and phaser driver stages should)ass little above 3,000 cycles.

The Schmidt phaser should be aligned with a 'scope (sweep disabled). Referring to Fig. 2-b, vertical deflection plates connected to the plate of V_{1a} or V_{1b} and horizontal plates connected to the opposite triode plate. Or, if your 'scope is dc coupled, then connect one set of deflection plates to A or B and the other pair to C or D.

Drive the phaser with a sine wave signal of 800 to 1500 cycles, and adjust P_1 for the best circle throughout the audio band. Maintain the input below the distortion level. Try voice input. The pattern should resemble a lace doily



* K8NIC/5 73 Apr. '62, p. 7.

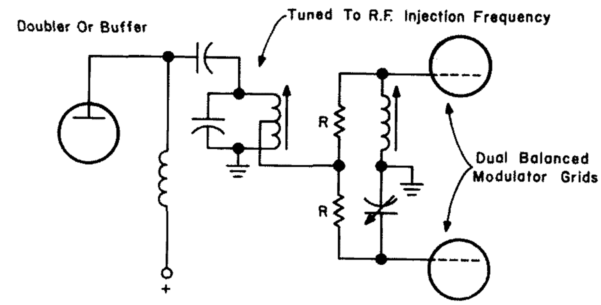


Fig. 3a. A typical 90° rf phasing circuit

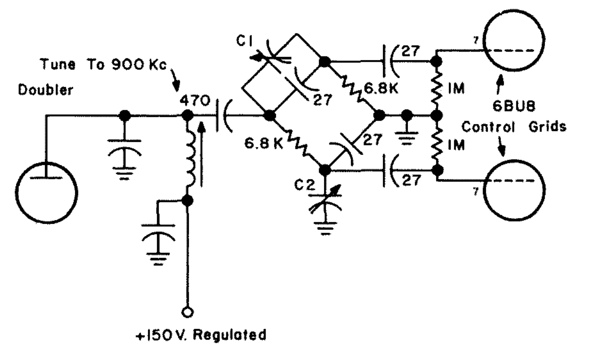


Fig. 3b. 90° rf phasing circuit preferred by author

due to voice wave complexity. The diameter will vary, but the pattern will remain essentially circular.

The Schmidt phaser makes use of the driving transformer inductance and the coupling capacitance, C_1, to accomplish the 90° phase shift. Theoretically this can occur at one frequency only. It is believed that R_1 and P_1 effectively lower the Q of the resonant circuit, extending the 90° phase shift throughout the speech frequency band.

But the adjustment of utmost importance is the phasing of the rf injection to the balanced modulator stage. Fig. 3-a and 3-b are suggested circuits for driving the 6BU8 control grids with 90° phase rf injection.

Fig. 3-b is preferred by this writer. This is an R-C bridge used by Heath and others. C was chosen at 27 mmfd. Its capacitive reactance at 900 kc is close to 6700 ohms. Resistors, R, were 6800-ohm composition type. Two small ceramic trimmers, C_1 and C_2, are in parallel with the phasing capacitors. Their purpose is to compensate for inequalities in resistance, stray capacity due to lead dress, etc. Coupling capacitors to the 6BU8 control grids are 27 mmfd. Grid leak values are 1 megohm.

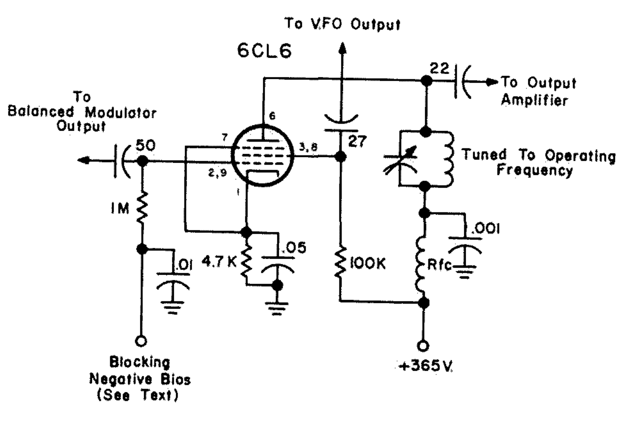


Fig. 4. Mixer with conversion gain

It is difficult to use a 'scope to check the rf phasing here due to stray lead capacity between the exciter and the 'scope. But the rf injection phasing *must* be very close to 90° or the signal will not be clean.

The injection frequency to the balanced modulator, 900 kc, was chosen because of (1) the availability of 450 kc crystals at 10c each, and (2) the desire to use one dual triode as a crystal oscillator and an un-neutralized isolation stage. A 12AX7 fills the bill by working as a crystal oscillator and doubler. It happens that 900 kc injection also produces a higher image frequency after mixing than 450 kc injection, giving an added bonus of less possibility of spurious emissions being transmitted.

Your VFO can operate either 900 kc above or 900 kc below the desired operating frequency. Sidebands are switched by Sw_1, Fig. 2-b.

On the subject of mixing, it was desired to select a mixer tube which would render some conversion gain. (See Fig. 4.) A 6CL6 was chosen for this purpose. Its control grid receives the balanced modulator output, while the screen grid is driven from the VFO output (about 10 to 15 volts rf) superimposed on the normal screen grid dc potential. The mixer output then drives a 2E26 output Class-A amplifier directly without the use of any buffer stage.

In operating the exciter the microphone preamplifier and phaser driver 12AX7, the oscillator-doubler 12AX7, the Schmidt phaser 12AU7, and the balanced modulator 6BU8's all operate continuously from a 150-volt regulated supply. The 6CL6 mixer and the 2E26 output stage are supplied with 365 volts unregulated, continuously supplied also.

The two stages receiving the 365 volts are blocked-grid keyed. Blocking bias is obtained from a voltage divider to ground from either hot side of the power transformer. A point of the voltage divider feeds a single silicon diode

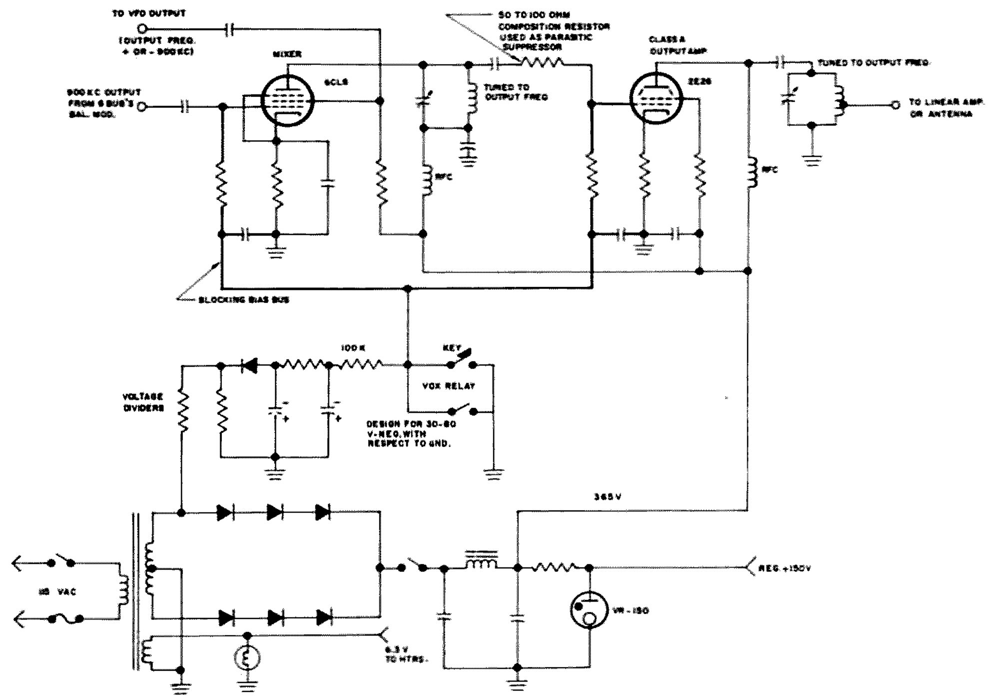


Fig. 5. Blocked-grid control system

and an R-C filter to produce 80 volts dc negative with respect to ground. (See Fig. 5.) This blocking bias voltage is fed to the grids of the stages to be blocked through a 100-K series resistor and thence through their respective grid resistors. The keyed stage grid leak resistors terminate in a common bus rf bypassed to ground.

Closing the key or VOX relay connected between the blocking bias bus and ground effectively short circuits the control grid's portion of the blocking bias, allowing normal grid leak bias to control tube emission. At the same time the bias supply is only grounded through a 100-K resistor, so the supply feels only a very light load. As soon as the ground is removed from the keyed grid circuit bus, the negative bias on the grids skyrockets and blocks plate current flow. Some of the best modern factory-built equipment employs this ancient trick.

Block-grid keying is extremely fast and relatively clickless. Using this method, the key becomes a "push-to-talk" switch on sideband and a key on CW (with carrier re-inserted). If you already have VOX and prefer it, simply wire the VOX relay across the key contacts for the dual function. All of this control jazz

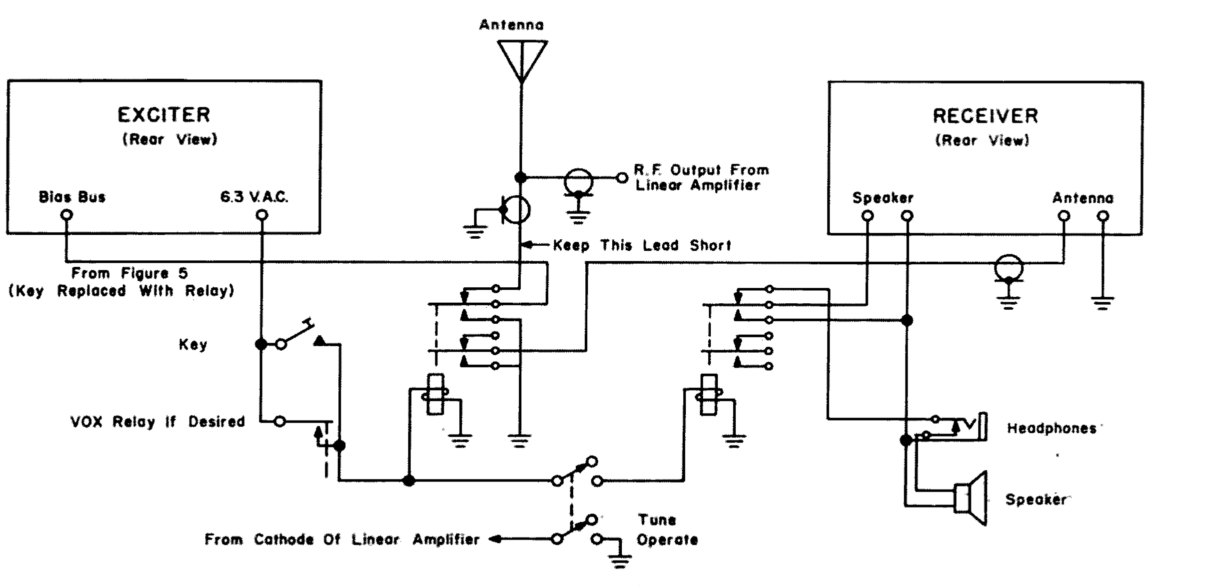


Fig. 6. The engineered system. The "tune-up-operate" switch allows you to talk yourself on frequency

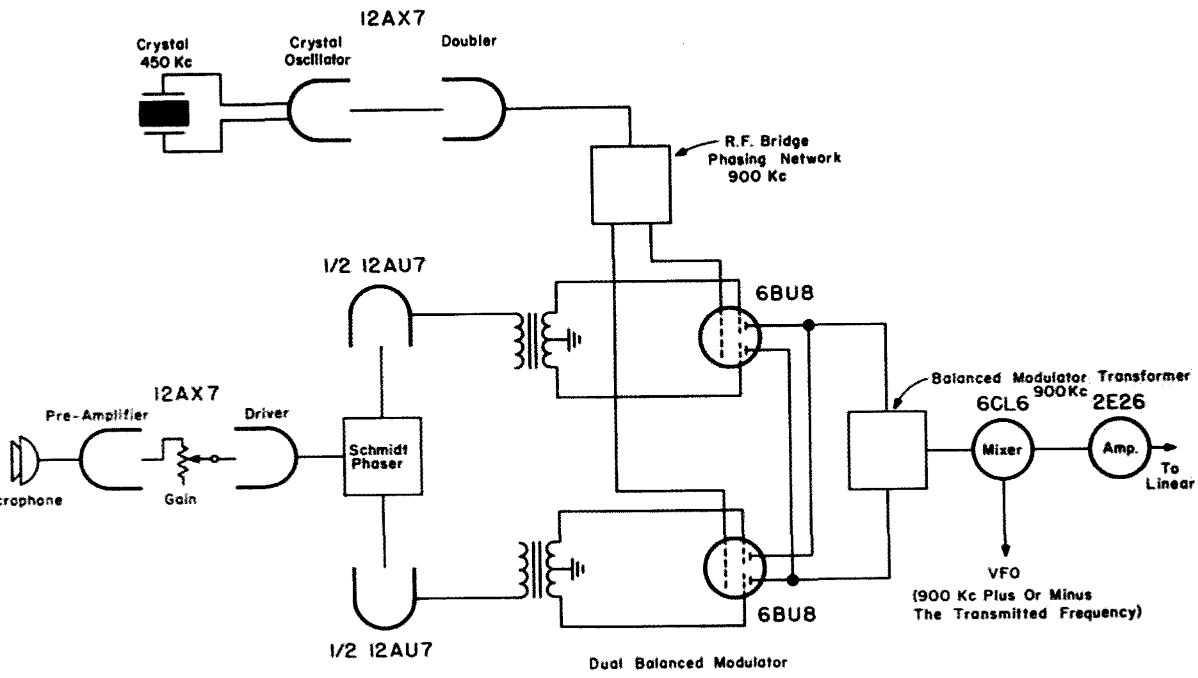


Fig. 7. Block diagram of W9IDP SSB exciter

is really what is referred to as "systems engineering," which means making the components in your station into an integrated "system."

In order to complete the systems engineering of the station layout, and some hams do encounter trouble in this department, the arrangement of Fig. 6 is suggested. A 6.3 volt filament lead is brought out from the power transformer to operate a pair of good quality 6-volt ac relays. These will key well up beyond 25 wpm, so have no fears about CW unless you operate 50 to 60 wpm.

The control functions to be accomplished by the relays are:

1. Receiving antenna disconnect; receiver antenna input grounding.
2. Speaker muting.
3. Transmitter keying, either by hand key, VOX relay, or "tune-up" switch.

Be sure to install the relays inside of some kind of box away from the exciter chassis and away from the microphone. The relay snap goes on the air with a very distinct "clack" otherwise.

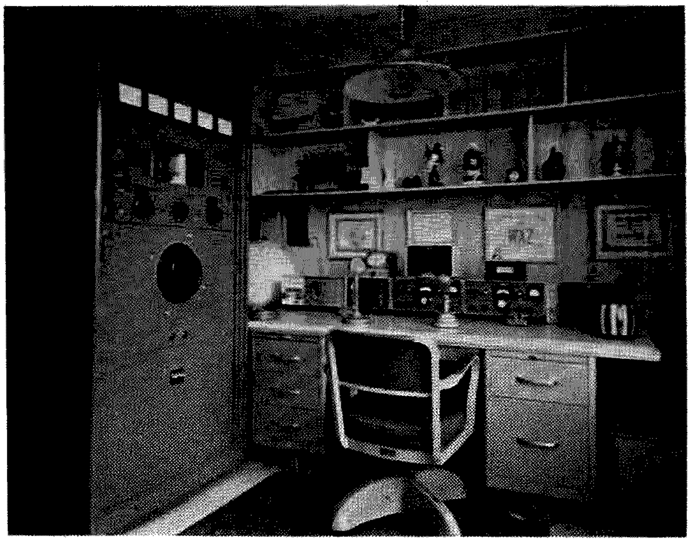
We have discussed the balanced modulator and its audio drive and rf injection, the Schmidt phaser, the importance of proper rf phasing into the balanced modulator grids, a dual balanced modulator for phasing exciters employing inexpensive tubes, a mixer with conversion gain, blocked grid keying, and the engineered system.

If nothing else is remembered, let one thing sink in. That is this. The rf injection to the balanced modulator must have as good 90° separation as it is possible to attain.

Use a good SSB receiver to adjust your transmitter before going on the air. A well shielded receiver with antenna input grounded can tell you a whole lot about your signal. First give a listen on the frequency. (Some hams are sensitive about people who test before listening.) Then ground the receiver antenna input with a very short wire, and make a short transmission with the rf gain of the receiver backed all the way down and the antenna trimmer rotated for minimum signal. Use the cans for this test. If the quality of your signal sounds good on this test, you have a pretty good chance of sounding good on the air.

Don't feel embarrassed at having to ask for criticism of your signal from fellow hams. Some of them with the store-bought kind tend to be a little too honest with the experimental gear types. But amateur radio is supposed to be a place where radio frequency experiments may be conducted. Hams can emit all types of signals. We are permitted FM, RTTY, single sideband, double sideband suppressed carrier, and even double sidebands with carrier.

During the process of developing the Schmidt phaser, the dual balanced modulator with 6BU8's, and the 6CL6 mixer, my signal was not always the best on the air. When concurring poor signal reports were received, though, I tried to do something about it. This is it, and I think you'll like it. . . . W9IDP

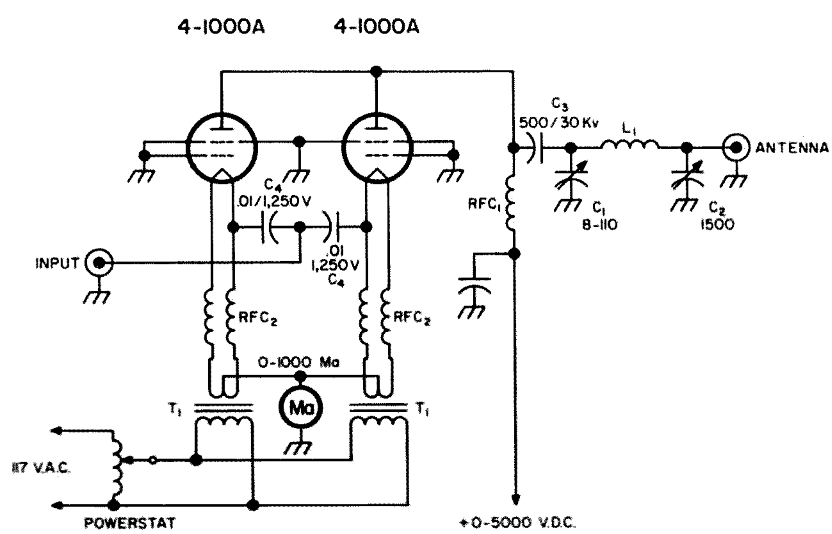


Bill Brown WØSYK
28 Marine Lane
Hazelwood, Mo.

The Big **Bomb**

The final of this transmitter started back in 1957. After running a kw with TW150, T200 and 250TH's I went out and bought a new 4-1000A and tried to put it in class C. After a year of confusion I gave up and put the final under the work bench. However, at the National Convention the following year a talk by Rex Bassett W4QS on the ground grided 4-1000A fired me up and once home I started changing my final from class C to class B.

I knew little about driving this tube so with 3000 volts on the plate could not load up to a kw input. Several months later after building a final using four 811's, and doing very nicely, I thought of using the same match with the 4-1000A as with the 811's. Dividing the 100 ohm impedance of the 4-1000A would give me 50 ohms output to 50 ohm input. For those who are thinking this final would exceed the legal power, let me remind you that any grounded grid linear's output is directly proportional to the drive so without a buffer stage this final will run the same output as a single 4-1000A.



The Big Bomb

Two tubes will permit the operator to coast along at low voltage without any tuning of the grid and without a matching transformer to get the desired kw input. Who knows how many years these tubes will rest at this voltage and current. As the photo shows there is a Powerstat which changes the dc voltage and my checks show it is not necessary to run these tubes (one or two) at 5000 volts to get maximum efficiency. With a plate voltage of 3000 volts, an efficiency of 70% has been checked. Other advantages include the following; no grid circuit, no neutralization, rapid band change (plate circuit only), no relay as plate voltage on at all times, making more desirable for remote operation since no screen and grid voltage are required. No danger of overloading capability of tubes with excellent linearity and stability. Photo also shows Powerstat on filaments which used with care can prolong the life of tubes. (Play radio engineer: bring the filament voltage up slowly and maintain the required filament voltage. Let the tubes cool off slowly after use.) The driving requirement matches perfectly the exciters now on the market; HT32, HT37, 32S3, 200V etc.

The circuit is very basic. Just parallel the plate and filament leads. Five meters are used reading from left to right; Grid & Screen 0-500 ma, High voltage 0-5000 vdc, RF output 0-8 amp., Filament voltage 0-15 vac., Plate current 0-1000 ma.

I desired maximum efficiency so I chose single band operation. Changing bands can be accomplished in seconds with separate coils. The power supply is a standard bridge using 4 872's. Since completion of the rig I have also tried solid state rectifiers using the Westinghouse silicon rectifier Oz-Pak for the past five months with fine results. The plate transformer is a 5 kva pole pig (7200 vac) bought through the power company most reasonably. It is controlled by a Superior Powerstat with a rating of 28 amps. The cabinet is by Par-Metal using 30″ panels. Filter condensers are 2 GE 120 μf @ 3000 volts. In series they give 60 μf at 6000 vdc. Chokes are in the negative lead and improved regulation is achieved by using swinging and smoothing chokes in series. Without parasitic chokes in plates leads the final was stable with voltage up to 6000 without any signs of taking off. My driver is a 32S1. I run 3500 volts for legal input knowing that I should be in business for many any years without tube failure or other types f breakdowns.

. . . WØSYK

If the world renowned Amperex 6360 is—as virtually all designers of mobile communications equipment agree—a truly great tube, its new derivative, the Amperex 8458 is an even greater one! For in addition to the great performance, great low-profile convenience, and great reliability of the earlier twin tetrode, the new 8458 can be counted on to deliver 30 watts of useful power at 175 Mc from less than 1.2 watts of drive power.

To drive the 8458, Amperex has developed a second new twin tetrode, the 8457, a 13.5 volt heater version of the 6360. It is ideally suited for use as a cascaded doubler-multiplier, driving the 8458 as a straight-through amplifier in the 150-175 Mc band. This combination of new Amperex tubes provides extremely stable power output under low voltage conditions, since more than sufficient drive is available. Because the profile heights of these two new tubes are identical with the older 6360, modification of existing circuit designs can be made with resulting improved power and performance.

Both tubes incorporate a 13.5 volt center-tapped heater; are internally neutralized and have indirectly heated oxide-coated cathodes.

8458
SIGNIFICANT CHARACTERISTICS
CLASS C RF AMPLIFIER AT 175 Mc

	CCS	ICAS
DC Plate Voltage	400	450 volts
DC Grid No. 2 Voltage	155	200 volts
DC Grid No. 1 Voltage	–59	–50 volts
DC Plate Current	85	110 ma
Useful Power Output	20	30 watts
Drive Power	1.0	1.2 watts

Both the 8457 and 8458 are immediately available in production quantities from stock. For complete data on these and other Amperex tubes for mobile communications applications, write: Amperex Electronic Corp., Tube Division, Hicksville, L. I., New York 11802.

Amperex®

IN CANADA: PHILIPS ELECTRON DEVICES LTD., TORONTO 17, ONT.

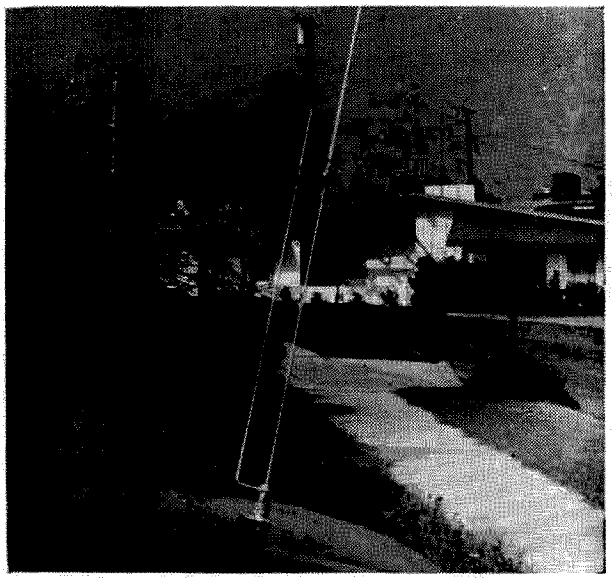
R. F. Van Wickle W6TKA
643 Aurora Avenue
Santa Barbara, California

Two for Two

Here are two easy-to-build antennas for two meters. Either can be used for fixed or mobile operation, but I prefer the 'J' on the car, and the coaxial (or sleeve) antenna on the house.

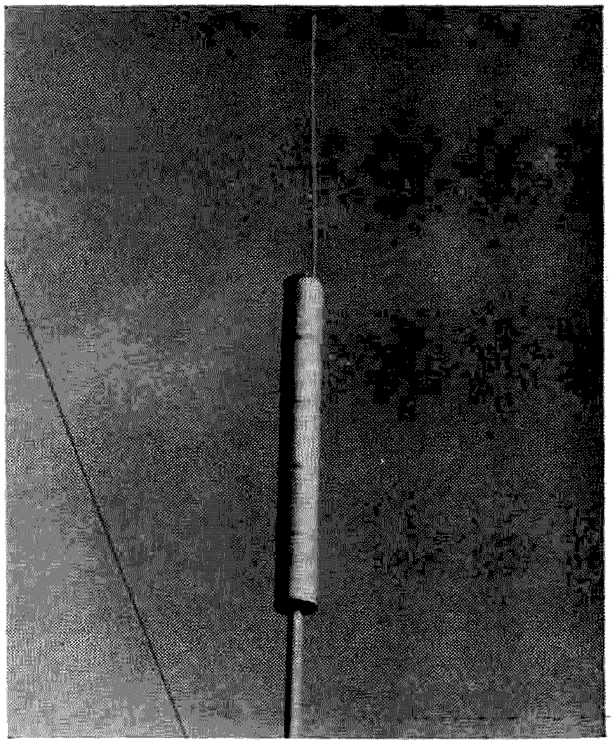
The J is popular for mobile operation here in California. One drawback to the antenna is that it can sometimes be difficult to construct and cumbersome in appearance. The W6TKA-J eliminates those problems. The mounting for the J consists simply of an aluminum bracket bent in the shape shown in the drawing and photograph, with a UHF-type coaxial panel connector mounted on the bracket. The bracket is held in place just inside the trunk lid by two sheet metal screws. A single hole through the lip of the trunk opening takes care of the RG-59/U cable running to the transmitter. Thus, no noticeable holes have to be drilled in the car to mount the antenna. Also, please note that this J is fed directly at the base with coax, and not at a 300-ohm point through a bulky balun.

It might be well to explain that the J is nothing more than a half-wave antenna fed with a quarter-wave matching section, consisting of the lower 19-inch section with the longer element spaced something less than



W6TKA-J Mounted on Car

two inches away. The J is *not* a three-quarter wave antenna, as I have occasionally heard it described. The lower 19 inches of the element that becomes the antenna and the second, grounded 19-inch section, do not radiate. As a matter of fact, if the long radiating portion of the antenna were bent at a 90° angle to the matching section, you'd have the old-fashioned "end-fed Zepp."



Completed Coaxial Antenna

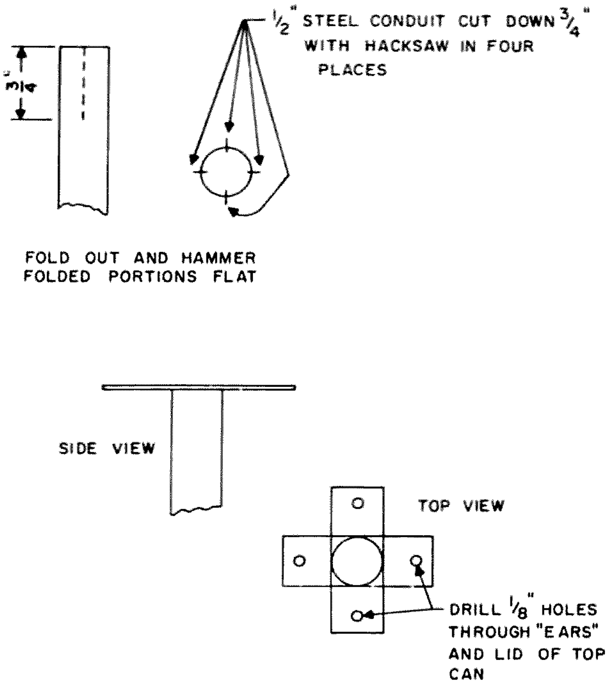
The antenna is built around a PL-259 UHF-type coaxial connector. Both elements are ⅛ inch half-hard brass rod, available from almost any metal supply house. Dimensions for the two elements are given in Table I.

The long piece of rod must be carefully filed until it will slip into the pin of the coaxial connector. The filed end of the rod and the inside of the connector pin are then tinned, and the rod "sweated" into place. Do not force the rod into the connector or the connector insulation may fracture.

Next, the shorter element is prepared. Make a 90° bend 2¼ inches from one end of the rod.

TABLE 1
"J" Antenna Dimensions

Frequency, Mcs	Length, In., Short Section after bending	Length, In., Long Section above connector
144	19¼	38½
145	19⅛	38⅛
146	19	38
147	18¾	37¾
148	18⅝	37½



DETAIL OF END OF CONDUIT PREPARATION FOR MOUNTING COAXIAL SLEEVE. REFER TO TEXT.

See Table I for the correct rod length. Then bend the last 1¼ inches of the 2½ inch section into a semi-circle of the same inside diameter as the outside diameter of the upper portion of the connector. Tin both the upper part of the connector and the loop that you have formed, and solder into place. At this point the shorter element will be spaced between 1½ and 1¾ inches from the longer element.

The upper part of the connector is now packed with small pieces of polystyrene foam, taking care to keep the antenna centered within the plug. Then, when the foam has been tightly tamped into place, use polystyrene cement to disolve the plastic. When dried, you will have a low-loss insulator which will keep the antenna centered in the plug.

To maintain the correct spacing between the elements over the entire length of the shorter element, a piece of plastic rod the same length as the spacing between the elements (as measured just above the connector) is placed near the top of the shorter element. In our case we used a plastic spreader taken from 450-ohm TV open-wire line. About ¾ inch of the TV wire was left extending on both sides of the insulator, and the wires twisted around the two antenna elements, and then held in place with plastic electrical tape. As a finishing touch, the entire antenna (except for the insulator and the connector, which were masked with masking tape) was spray painted aluminum, and the plastic tips

TABLE II
Coaxial Antenna Dimensions
(Same dimensions apply to both sleeve and radiator)

Frequency, Mcs	Length, In.
144	19¼
145	19⅛
146	19
147	18¾
148	18⅝

from an old "rabbit ears" indoor TV antenna were placed on the ends of the two elements.

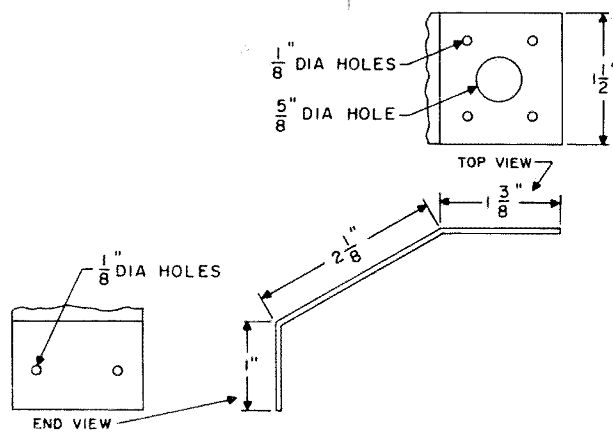
The antenna is easily removed when garaging the car, and has little wind resistance. Best DX to date—with one watt output from the transmitter—was a station in San Diego, California, contacted while driving through downtown Los Angeles—a distance of some 100 miles.

Now for the coaxial vertical antenna. There we used frozen orange juice cans (yes, other flavors will work!), and soldered them together. Five cans, each 3¾ inches long, with both ends removed (except for the top can, which has one end left in) were used to make up the sleeve. Using tin shears, the lower can is trimmed so that the overall sleeve length corresponds to the dimensions given in Table II. One word of caution: not all frozen juice cans are steel. Some are aluminum—even within the same brand we found both metals being used—so choose the cans with care. If a can won't solder, chances are it is not steel.

A small ceramic feed-through insulator (E. F. Johnson No. 135-44) was installed in a hole drilled in the top can lid, and the center conductor of RG-59/u coaxial cable connected to the insulator stud. The braid of the coaxial cable is soldered to the inside of the top can.

Next, take a ten-foot length of one-half inch steel "thin-wall" steel conduit, available at hardware or electrical supply stores. Split one end using a hacksaw as shown in the sketch. Feed the coaxial cable down through the conduit and out the other end. Then fold

Mobile J Antenna Mounting Bracket



J ANTENNA MOUNTING BRACKET

back the slit portions of the conduit so that it will fit tightly into the end of the can in which you have installed the insulator. Then drill at least two holes from the lid side of the can through the lid and through the split portions of the conduit. Use sheet metal screws to hold the lid in place.

The next problem is soldering the cans together—which really isn't much of a problem if you have a good 100 watt iron, *non-corrosive* soldering flux, and resin core solder. First, "tack" each can in place with solder at about four places around the periphery of the can. Then go back and solder heavily all the way around. I laid the assembled portion of the antenna flat and held the cans between stacks of old books.

When you finish, you should have something that looks like the antenna shown in the photograph—except, of course, for the radiator itself, which we have not yet installed. Now take a piece of polystyrene foam and cut it circularly the size of the inside diameter of the lower can. Make the foam just a little oversize, so it will fit tightly. Then, cut the piece of foam in two, cut a semi-circle in each half for the conduit, and put the two pieces in place to hold the end of the assembled sleeve equidistant from the conduit.

Now cut a piece of aluminum clothesline wire (see Table II for correct length). Make a 90° bend in the wire at a point one-half inch from one end. Then bend the one-half inch portion into a semi-circle so it can be attached to the insulator. It will probably be necessary to use two ¼-inch washers on the insulator to attach the antenna securely.

And that's the coaxial antenna. Just mount it where you want it, by means of clamps to a mast or the side of the house, run the coax where you want it, and you're on the air.

With the J on the car and the coaxial on the house, you can drive around the block talking to yourself!

. . . W6TKA

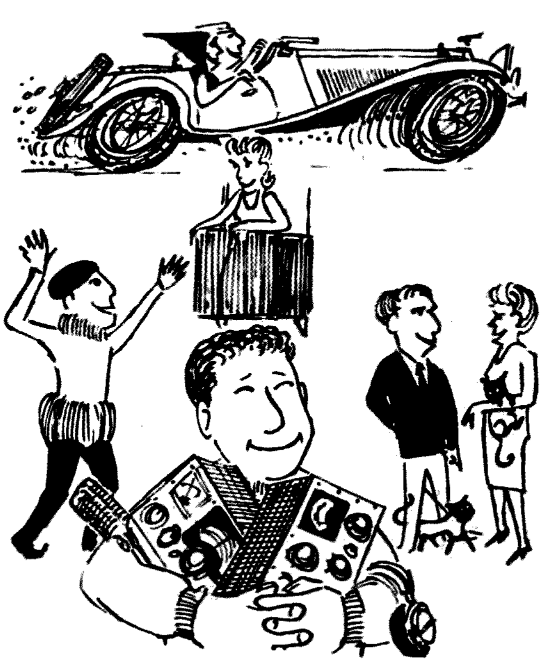
Sylvia Margolis
95 Collinwood Gardens
Ilford, Essex, England

Illustrated by Wayne Pierce K3SUK

The Trouble With Fred . . .

You couldn't call amateur radio a sexy hobby—like amateur dramatics, for instance, where a Romeo and Juliet might find themselves truly wedded and bedded before you could say Wherefore; or Siamese cats—"Why doesn't your queen get together with my tom . . . ?"; or veteran cars—"Come up to my apartment for a quiet evening, honey, and I'll show you my rally route . . . "

No, radio amateurs are a pretty stolid lot as a rule. Never let it be said, though, that their chemistry doesn't work in the orthodox manner. The science of electronics is so wonderful that the time may very well come when other arrangements might be possible. Until then radio amateurs are apt to come to heel eventually, no matter how great their resistance. That was the trouble with Fred.



You couldn't call ham radio a sexy hobby—like dramatics or vintage cars, or Siamese cats . . .

There are nine amateurs in our town and we stick together for mutual protection as much as for personal friendship. It's far easier to hunt the DX in an organised pack than to have everybody QRM'ing everybody else. TVI sorts itself out more easily when friends rally round to help. The wives can get together, too, to air their mutual grievances. That was our downfall.

For Fred and I were true friends, besides having the hobby in common. We had gone to the same school and the same college—he to study accountancy, me to learn engineering. We were the best of buddies.

The trouble with Fred began when his mother, after ten decorous years as a widow, threw her heels over her head and married a guy out on the West Coast. She signed the old house over to Fred and off she went, leaving the poor boy to fend for himself. I guess she thought he should be O.K., pushing 40 as he was. He had the house he had grown up in and Myrtle, who came in twice a week to clean. What more did he need?

He needed plenty. The old lady had spent her lonely years spoiling him like the big baby he resembled. For Fred, with his round face, big cuddlesome frame and helpless expression, had the sort of little-boy-lost look that sets the hormones buzzing in any woman, from nine to ninety. They all wanted to mother him. He had been efficiently mothered for forty years and suddenly had to look after

imself. The result was chaos.

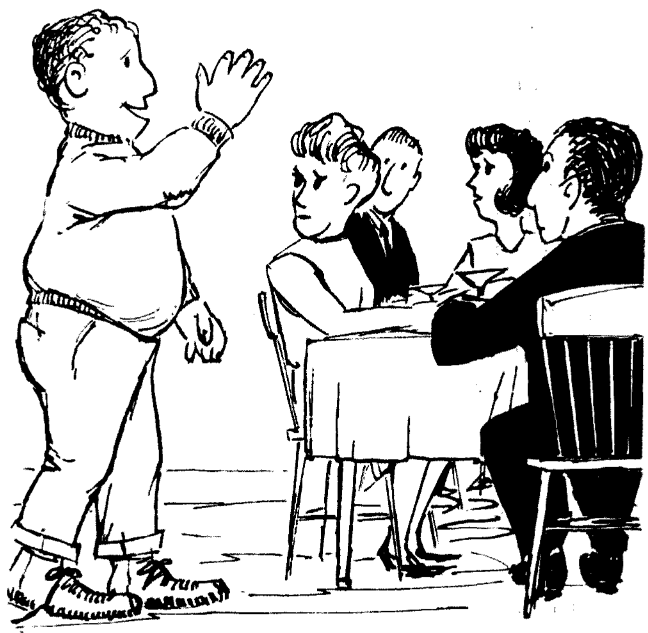
His shirts, for instance; he came to our house one night with one button obviously issing. Later that week I noticed two butons adrift. He seemed blissfully unaware that nything was wrong but, when he came the hird time with more buttons missing than present, Janet, my wife, offered to do a little ending for him. He came next day with grip full of perforated socks and buttonless shirts. It took Janet a week to get him mended again.

Food was an even greater problem. His own catering experience was rudimentary and that chubby body took a lot of stoking to eep it comfortable. He ate occasional meals in a road-side joint, where he got nothing but heartburn. Myrtle fixed him something now and again, but a man has to eat more than twice a week. So Fred got to dropping in at our house just before meal-times. What could Janet do but offer him lunch—or diner—or breakfast—or a midnight snack when here was a contest on? No housewife could bear to dish up good food with a lonesome man watching, drooling and eyeing the apple ie wistfully and with affection, especially hen the man was someone as appealing as Fred and the housewife as tender-hearted as anet.

As I say, Fred was a regular visitor. Sometimes, though, Janet would have arranged a inner party, with all the best china, glass and silver, with linen napkins instead of paper and an equal number of men and women. It ight be an important client of mine we were entertaining, or some old friend from Janet's chooldays for whom she wanted to put on e style. There we'd be sitting, all dressed p, with me mixing martinis as if we had them every night, and the conversation going nicely —easy and sophisticated and plenty of status mbols showing. And in would lumber Fred tell me that a ZD9 was on. Fred would be wearing sneakers and an old sweat shirt but who would have the heart to send him away?

We weren't the only victims of course. Fred was engaged for weeks helping Bert to build a sideband rig—takes time and care to o a job like that. And a man can build up a hearty appetite. So Bert sat Fred down and very appreciative he was, for he loved homecooking and it had been his mother's boast at no store-cake ever crossed her threshold.

One weekend George put up a log periodic, e first in our area. It was just like Field Day, with people driving in from miles around on the Saturday to help or to admire. Doris



Fred would drop in on a dinner party dressed in sneakers and a sweat shirt . . .

fed them all coffee and pie but, when everyone had gone home, there was Fred still helping George, so Doris had to invite him to supper and to stay the night, so that he and George could make an early start on Sunday morning—after a huge breakfast.

So there it was. We all genuinely loved the big lug and enjoyed his company. It was the wives who ganged up on us—they decided it was time Fred got married.

George and Bert and I did our very best to protect him. We argued, pleaded, threatened but Fred's fate was sealed. It was just a question of finding the girl. This presented the wives with a serious obstacle which delayed their plans for a while. We thought it might render our friend safe, for we knew our Fred. He was terrified of women. Married women, particularly those who fed him, were OK but if a single girl so much as breathed on Fred, he would hang his head, his baby-soft skin would flush the prettiest and most appealing shade of pink and he wouldn't say a word. Fred's conversation was limited entirely to radio. He lived radio. Jayne Mansfield might be the answer to my prayer, or Bert's or George's. All Fred would ask was did she work AM or SSB?

This, you understand, had considerably hampered his sex life so far but Fred didn't seem to mind. There was always food as consolation.

So the girls had themselves a problem. And the girls solved it and in the most cunning, dirty, under-handed way . . . after all, Fred was a sitting target, plump and ripe and

tempting, eligible and attractive and well-heeled, just waiting for the first predatory female who could demonstrate a devoted, nay, an obsessional love for amateur radio.

Doris' niece arrived in town. I suppose she could have been called a nice-looking girl, even if a bit too managing for my liking. She intended making somebody a wonderful mother, even if it was Fred, to begin with. That didn't justify the iniquitous plot that our wives concocted . . . they sold the idea to Patsy in one marathon session, when we were too involved working the sideband contest to stop them. Next thing I knew was that my ARRL Handbook mysteriously disappeared for some weeks. So did George's RSGB Handbook. Even then we could have rescued Fred if we had realised that the books had been smuggled out to a very clever girl with a retentive brain, determination and desire for a husband.

The trouble with Fred came to a head at Christmas, when all the local amateurs and their wives got together for a party—there being no contests to work that weekend.

Doris brought her over to us—I remember so clearly, in the same way that a picture of a fatal disaster remains clearly etched on the victims' memories. There were George, Bert and I, happily discussing the possibility of fitting mobile sideband transceivers, when up slithers Doris. You could almost hear the rattle at the end of her tail. Beaming at her side was this dame, Patsy.

"Hello, Fred," hissed Doris. "Do you know my niece, Patsy?" And off she coiled, leaving Fred to go into the mumbling and blushing

Fred was left alone with Patsy . . .

routine. Never will I forget what happened next. It was cruel, heartless. It wasn't cricket. Nor was it baseball, football, handball or tennis.

"I heard you men discussing sideband transceivers," said Patsy brightly, "Tell me—what kind of sideband generation do you use—crystal filter, phasing or mechanical filter?"

It was horrible to see. Fred raised his head. *This* he had never seen. Then he proceeded to tell her, in very great detail, exactly which kind of SSB generation he did prefer—and why. Our Fred, roped and bridled, trotted meekly into the corral, waiting for his saddle.

They were married within weeks. There was nothing to delay them. Patsy moved into Fred's house and shared not only Fred's bed but his cubical quad too.

Of course they were happy. And Patsy had learned just enough amateur radio to trap Fred, but her interest was aroused and those first blissful, honeymoon weeks must have been interspersed with passionate lessons on circuit diagrams and regulations, for soon Patsy had a call of her own.

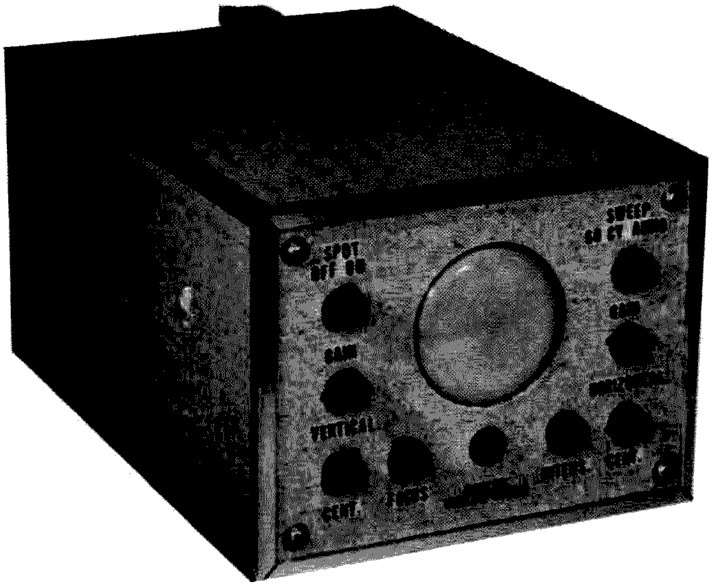
A year went by and, for the first wedding anniversary Patsy had Fred buy her not diamonds, not mink, but a genuine 5-carat furrier-designed linear, which must have set him back a helluva lot but that's what a guy will do for love. Theirs was now the biggest signal in the town and you could see this in Paty's attitude to the rest of us—a kind of patronage which we began to resent.

I should have known it was to be big trouble when, some weeks after Fred and Patsy had gone up into the linear class, Bert mentioned to me casually that Fred had visited them the previous evening and stayed for supper. It seemed that Patsy had a sked she just couldn't miss and there was no time to cook supper. Then one day he arrived at our house just before lunch. He plainly had all the time in the world to spare, for Janet called me twice for lunch. Then she came into the shack to find me.

"Hurry and wash," she said, "Lunch has been ready for ten minutes already. I guess Patsy has your lunch waiting for you, too Fred."

"Well, Janet," said Fred—and it was quite like old times—"you see—Patsy has been kinda busy this morning. There's a ZD7 coming up on 20 and she needs him to make her century—so she just didn't get around to cooking . . ."

It was while Fred was tackling a king-sized portion of Janet's pot-roast that I noticed there were two buttons missing off his shirt . . . Sylvia



A Versatile Oscilloscope

Harvey R. Pierce WØOPA
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In my previous articles in 73 Magazine I described the "Simplescope" monitor and then a more advanced design in "Complicating the Simplescope." Both of these were excellent monitors, but the Simplescope was limited to monitoring high-level AM, and the improved version merely added a wide-band vertical amplifier so it could be hooked to a receiver.

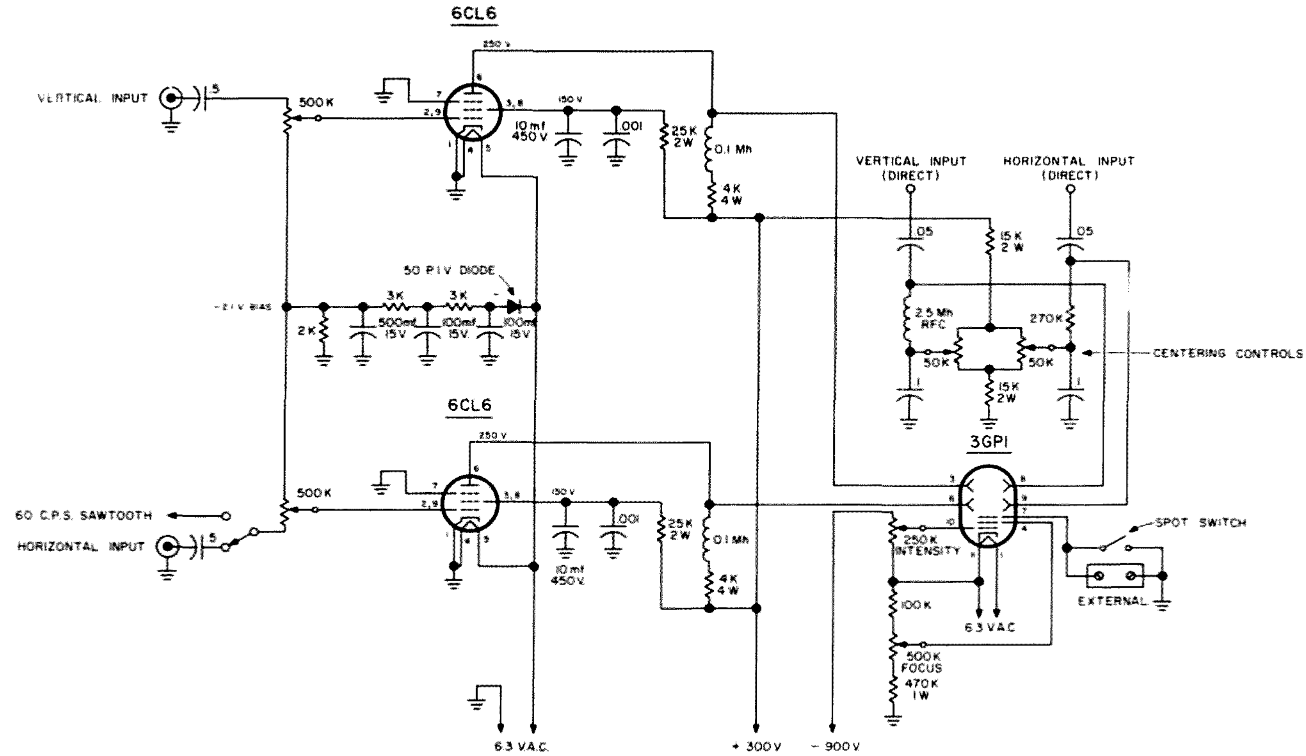
I felt there was a need for a more advanced design: something that could be used with low-level modulators as well as high-level, for SSB and DSB, and with receivers, provided this could be done without at the same time being too expensive or too complicated for the ham builder. A sort of minimum oscilloscope for all-around monitor use, but not necessarily for other scope purposes.

With the above in mind, specifications were drawn up. For low-level work, wide-range amplifiers for both horizontal and vertical deflection would be necessary, and these amplifiers should have fairly high gain and no phase-shift to blur the pattern. The scope should have direct input to both vertical and horizontal plates for high-level work, and for frequencies above the range of the amplifiers. Construction should not require expensive or hard-to-get parts. The circuit should be as simple and fool-proof as possible. Centering controls should be used, and a 60-cycle linear sweep would be nice if the circuit was simple.

The diagrams and pictures show what was done. The 6CL6 video amplifier circuit used in "Complicating the Simplescope" had proved satisfactory so it was used again, with minor changes. (See Fig. 1) A small (1/10th mhy) rf choke was added in series with the 6CL6 plate load resistors to improve the response at the high-frequency limits. The 6CL6 plates connect directly to the deflection plates to avoid phase shift. A bias supply for the 6CL6 grids was added to prevent any low frequency degeneration from cathode bias. Identical amplifiers were used for vertical and horizontal deflection.

The amplifiers connect to only one of each set of deflection plates, and direct input is available to the other two plates. The direct input plates also connect to the two centering controls. Of these two, the vertical plate is isolated (decoupled) from the vertical centering control by a 2½ mhy rf choke, allowing high-level rf to be fed to it, while the horizontal plate is decoupled from the horizontal centering control by a 270k ohm resistor, allowing either high-level af or rf to be fed to it. Both plates are connected to the direct input connectors by capacitors, and if direct input is not used, the connectors may be grounded, thereby bypassing these unused plates to ground.

When the amplifiers are not in use, the low



Versatile oscilloscope

impedance of their plate circuits (less than 3,000 ohms) keeps them from having much effect on the direct deflection.

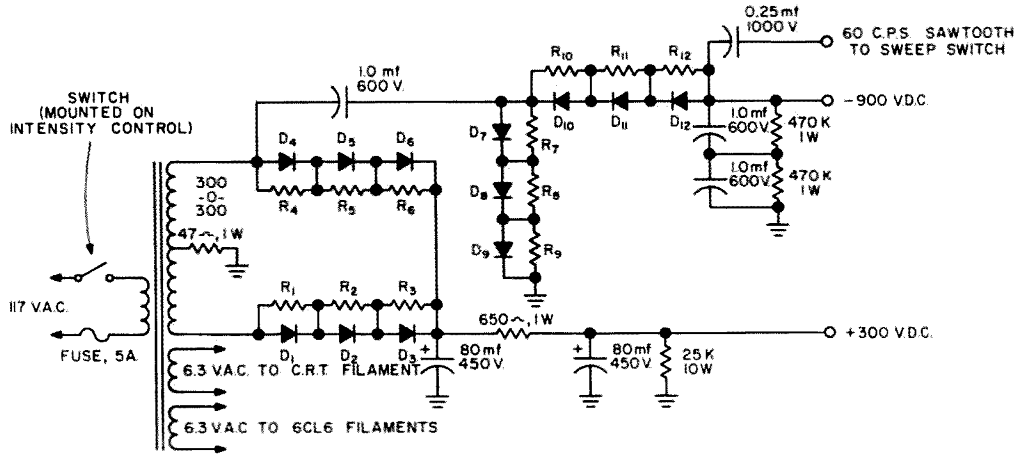
The power supply (see Fig. 2) uses a TV power transformer and low-cost silicon diodes in series as rectifiers. The diodes save space and heat. Resistors equalize the voltages for the diodes. A conventional full-wave rectifier supplies a positive 300-volts for the amplifiers, while a voltage doubling circuit supplies about 900 volts negative. Together they supply about 1200 volts for the cathode ray tube (crt). The voltage doubler produces about 6 volts of beautiful 60-cycle sawtooth ripple, which is used for the linear sweep voltage.

Provision is made for blanking the spot by opening the lead to the last crt anode, either by a front-panel switch ("Spot Switch") or remote relay. This blanking is desirable during standby periods to prevent burning of the phosphor screen by an unmoving spot. Other methods of blanking can be used, but this seemed the simplest and involved nothing but ground potential.

In building this instrument, primary consideration was given to short grid and plate leads because of the high frequencies involved. (See Fig. 3). Second came ease of construction, then cost and size. Last came cabinet or enclosure. The basic design, as shown in the pictures, consists of two aluminum plates, one at each end of the crt. A third plate forms the rear, on which is mounted the power transformer, fuse, and all connectors. The three plates are held together by four threaded rods, one at each corner.

The cabinet shown in the pictures was an experiment. It is made of one eighth inch tempered hardboard covered on the smooth side by self-adhesive vinyl film and on the inside by thin sheet aluminum. It is held together by outside-corner molding for wall tiles (from Sears, Roebuck) and the four tie bolts. The ventilation holes are backed by perforated

Rear view. Connections for remote control of spot to the right of transformer, fuse and ac connector on left. Input connections (3-way binding posts) across the top. Handle at rear top for balance.



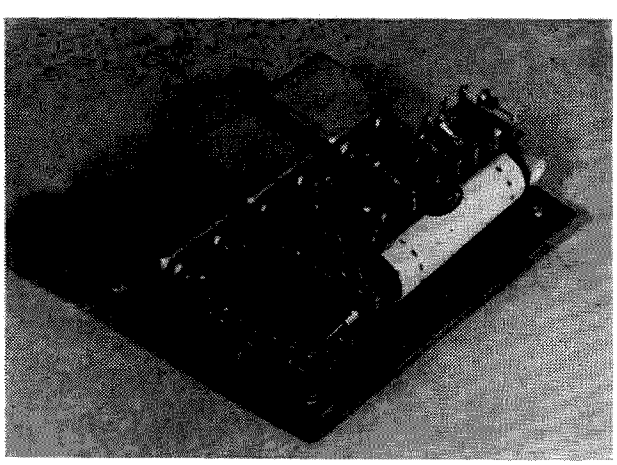
D1 - D12 - 500 Ma, 400 P.I.V.
R1 - R12 - 820 K, 1/4 W

Oscilloscope power supply

aluminum. While it made a fairly handsome case, it proved as hard to build as the scope itself, so some more common method is recommended.

The aluminum plate at the rear of the crt is the main "chassis" and its layout (Fig. 3) should be followed closely in the interest of short leads and maximum high frequency amplification. With a little care, the 6CL6 sockets can be positioned so their grid lugs can be soldered directly to the center lug of the adjacent gain control, and their plate lugs a minimum distance from the crt deflection plate pins. Position the 60-cycle/audio sweep switch for shortest leads to the horizontal gain control, and keep the lead away from the chassis.

Crt sockets are hard to come by, so in this case a hole was cut in the chassis to clear the crt base, and a clamp devised to hold the tube firmly in position. Connections were made



The rectifier/filter sub chassis. High-voltage diodes in foreground,, high voltage capacitors in rear. Low voltage diodes on terminal board above the two 80 mfd capacitors.

to the tube pins by socket clips and flexible leads obtained from three discarded TV picture tube sockets. Your local TV service man may have a few to spare. Or you can make your own leads using clips from old octal sockets. Use insulation tubing over the clip lugs to avoid shorts and allow enough slack in the leads to permit rotating the crt 30 degrees or so later to level the horizontal trace. The keyway ridge of the crt base should be on the bottom.

Vertical and horizontal centering (positioning) controls are mounted directly below the gain controls. Between them, below the tubes, tie-points are placed as needed to support the amplifier and bias supply components, and a long, multi-point strip is placed along the bottom edge of the chassis plate for the connections to the other units. (Transformer, front panel, rectifier/filter sub chassis.) The shaft extensions shown in the pictures are birch dowel (cheap) but metal is best.

To conserve space, the large electrolytic capacitors for bypassing the 6CL6 screens and for the bias supply were placed on the tube side of the chassis. The screen connections were brought through the metal by feed-thru capacitors, for better bypassing at the high frequencies. If preferred, .001 or .005 mfd disc ceramics connected at the tube socket lugs could be used in place of the feed-thrus.

A hole is cut in the front panel about ¼" greater in diameter than the crt face and the tube is cushioned by four soft rubber grommets pushed into slots around the hole. On this panel, below the crt face, are mounted the focus and intensity controls and a pilot light. (The latter may be omitted, if you wish. If

used, a light shield must be provided to keep it from shining on the crt face from the back.) The power switch is on the intensity control.

To insure proper alignment of shaft bearings, tube face, and tie bolts, this panel and the main chassis should be clamped together and small centering holes drilled thru both sheets for all holes common to both. These holes may then be enlarged to the sizes needed. In the scope pictured a separate "dress" panel was used to cover the grommets, bolt heads, etc. A hint—it is a big help to use color-coded wires between this panel and the main chassis.

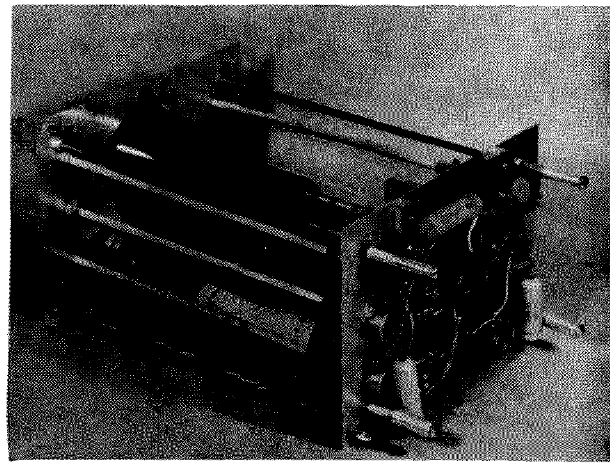
Rectifier/filter/bleeder components are mounted on an insulation board that clamps to the tie bolts, underneath the crt. The placement of parts will depend a great deal on the size and shape of the capacitors used. In the picture the full-wave diodes are mounted on an insulation strip over the two 80 mfd electrolytics, and the voltage-doubling high-voltage diodes on one corner with their metal-cased capacitors along the edge. Bleeder and filter resistors are underneath, as is a tie-point strip for the connections to the transformer and main chassis.

The power transformer is mounted on the rear panel so the crt will be as far from its magnetic field as possible. All connectors are on this rear panel, as well as the input capacitors and the fuse. Be sure to have long enough leads attached to the units on this panel to reach the appropriate points on the main chassis when assembled. I used a cheater cord connector from an old TV set for the power cord because I dislike cords dangling from unused instruments. If you don't have one it may be omitted.

The four units are wired separately, then assembled and wired to each other. Color coding of the wires is a big help. Otherwise, care should be taken to identify each wire as it is hooked up.

No exact dimensions have been given, because I feel that in a project such as this the builder should be free to accommodate his own ideas and parts. Placement of gain controls, amplifier tubes, and crt as shown in Fig. 3, with the rear panel close behind, assures short lead where short leads are important, and the power transformer must be behind the crt. The rest of the construction can be done any way the builder chooses.

There are few critical parts. The amplifier plate load resistors are made by connecting two 8200 ohm, 2-watt carbon resistors in parallel to make the 4,000 ohm, 4-watt resistors required. The screen resistors are 27,000



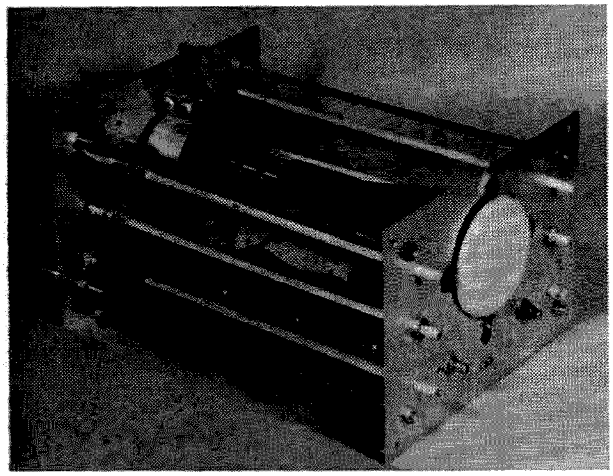
Interior view, showing rear of main chassis, general construction, placing of rectifier-filter sub chassis, and bolt extensions for rear panel.

ohm 2-watt, 20%, carbon resistors that checked close to 25k on an ohmmeter, but 25k 10-watt wirewound resistors are OK at added cost. The resistors in the bias supply were selected to give 2.1 volts bias at 1 ma. Any other combination that comes out with 2.1 volts will do as well.

The .25 mfd/1000 volt capacitor used to couple the sawtooth ripple of the voltage-doubler supply to the horizontal input (Sweep Switch) must be of very high quality. The permissible leakage is one micro amp, but even this is a bit high. Leakage resistance should be well over 1000 megohms. Too much leakage will over-bias the horizontal amplifier.

The power transformer should have two 6.3 volt heater windings, and its high voltage secondary should be good for at least 100 ma; the actual voltage can be anything from 500 to 750 volts centertapped, with 650 about right. The experimenter can change the value of the filter resistor to obtain not over 300 volts of dc for the 6CL6 plates according to whatever voltage the transformer has.

Once wired and assembled, the first test is the usual "smoke test": plug it in and see if anything overheats. (Note—the 6CL6 plate resistors normally get pretty hot.) Voltages should be checked next. They should be reasonably close to those indicated in the diagram. Be sure the voltage-doubler high voltage is NEGATIVE to the chassis. (This point bothers some builders, they are so used to high voltages being positive to chassis!) Be sure the bias voltage is right, 2.1 volts. Check the .25 mfd/1000 v sweep coupling capacitor for leakage: with the sweep switch set for 60-cy. sweep a vtvm should measure no more than —5 volts to ground from the switch side of the capacitor.



Interior view from the front, showing mounting of the crt. Note clamp for tube base, four grommets around face.

If all voltages are present and reasonably correct turn the spot switch on and advance the intensity control half way. With both gain controls turned full off and the centering controls half advanced, a spot should appear on the screen. It will be noted that the centering controls will move the spot further off center in one direction than the other, and there may be a slight interaction between the focus and intensity controls. If there is leakage in the 60-cycle sweep coupling capacitor, the horizontal gain control adjustment will have an effect on the horizontal centering. None of these irregularities affect the use of the instrument.

A simple operating test is to jumper the vertical and horizontal amplifier input connectors together and set the sweep switch to the audio position. Apply 5 or 6 volts of ac (any frequency to 10kc) from the jumpered inputs to ground. A straight line should appear on the crt face, and by various adjustments of the two gain controls this line can be made to assume any angle over a range of 90 degrees between horizontal and vertical. Try all combinations of control settings. Any curvature, especially at the ends of the line, indicates distortion, and if everything is normal the line should extend ¾ths the width of the tube at any angle before curving. Excessive distortion indicates amplifier trouble, usually improper bias.

Note carefully the areas of the crt face where distortion is evident in this test. In any future use of the instrument these distortion areas cannot be depended upon to give a true picture of things.

By now you should be familiar with the controls. Now is a good time to level the trace by loosening the crt clamp and rotating the tube so the horizontal line formed by the 60-cycle sweep is level with the vertical gain off. The scope is now ready to use. All four inputs—vertical direct, vertical amplified, horizontal direct and horizontal amplified—are independent of each other; they can be mixed in any combination and used simultaneously if desired. Switching from direct operation to amplifier use is thus avoided in many uses.

Amplifier input (sensitivity) for full-screen deflection in this scope is 1.5 volts horizontal (rms) and one volt vertical. Full screen deflection requires about 80 volts (rms) at the horizontal direct connector, 100 volts for vertical. Frequency response of both amplifiers runs from 15 cycles to something over 4.5 megacycles within 3db. The vertical direct (rf only) input range is from about 400 kc to well over 50 megacycles. The horizontal direct input frequency range is from about 20 cps to over 50 mcs. Input sensitivity varies somewhat with the voltage on the crt, so the figures above are not absolute values.

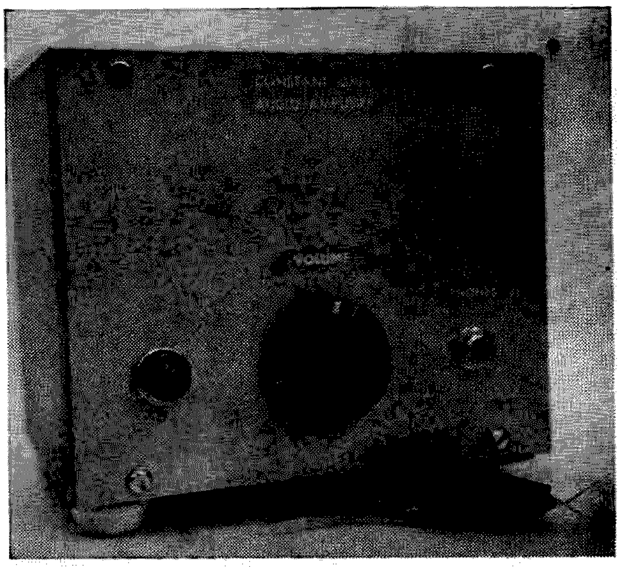
Within the frequency and sensitivity ranges above, this instrument can be used for the usual forms of radio monitoring, and a few not so usual. For instance, with the vertical amplifier input connected to the receiver if and an rf pickup from the transmitter connected to the vertical direct input, and the 60-cycle sweep, you can watch received signals and your transmitted signal without doing any switching of the scope as you go from receive to transmit and back.

The main limit to the versatility of this instrument is that the linear sweep is only 60 cps. This is no great handicap in monitoring, and may be an advantage because it "stops" all 60- and 120-cycle ripple and hum so common in electronics and clearly identifies them. A minor limit is sensitivity, though there will be few times when it is desired to "see" voltages less than the ¼ volt (rms) that gives about the smallest usable pattern (about ½ inch) through the amplifiers.

It is beyond the scope of this article to cover the uses of this instrument, because its applications are so varied. Of course, due to simplification and corner-cutting it cannot compare with standard scopes for all-round use, but the cost of parts is moderate compared even with the kit scopes, it is an interesting building project, and the finished instrument will monitor just about any transmitter you have. I put an antenna and a tuned circuit coupled to the vertical amplifier and got a good pattern from a local BC station five miles away. (They had good modulation, too!)

. . . WØOPA

Credit for the pictures goes to Bob Rode WφBRE.



Save your ears with this interesting circuit.

Steven Pullman

Constant Gain Audio System

Do you go deaf every time a local joins a QSO you are holding with an XZ2? Is he 60 over 9 while the XZ2 is S7, or is that four way QSO keeping you riding the gain control? Here's a solution to your problem—an amplifier that will keep the audio level from shattering your eardrums while you sit back and relax.

Several months ago a company came out with a variable resistor that is controlled by low voltage dc or ac. The information that I received from them had several interesting circuits, one of which was a constant gain audio stage. I rushed out and checked the price of this variable resistor. Upon hearing that the price was $11.00, I decided to forget all about it.

This variable resistor is actually a sensitive photocell and a small light bulb sealed together. A photocell will exhibit a very high resistance across its terminals with no light striking its face, and a very low resistance when exposed to a quantity of light. I started experimenting recently, and found that an Amperex ORP63 cadmium sulphide photocell exhibited the resistance characteristics that were needed. This cell is very sensitive and with no light on the cell, it exhibits a resistance of better than 10 megohms. The ORP63 and a number 40 pilot light were taped together with black electrical tape and made light tight. Fig. 1 shows a plot of resistance of the cell versus voltage to the bulb. As can be seen, the resistance varies exponentially from better than 10 megohms to as low as 300 ohms. The total cost of this combination is approximately $1.60 as compared to the commercial device costing $11.00.

Fig. 2 shows the first circuit tried. This

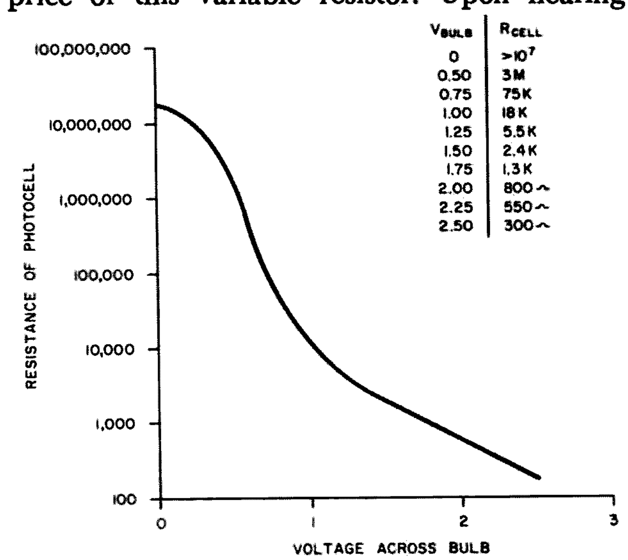


FIGURE 1

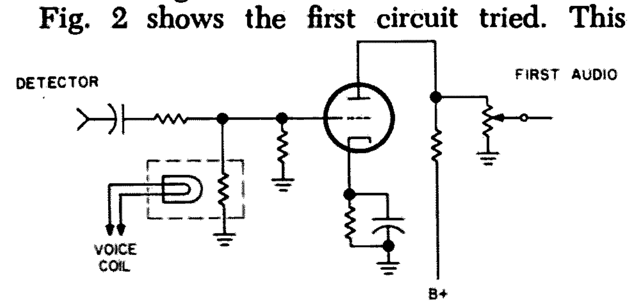


FIGURE 2

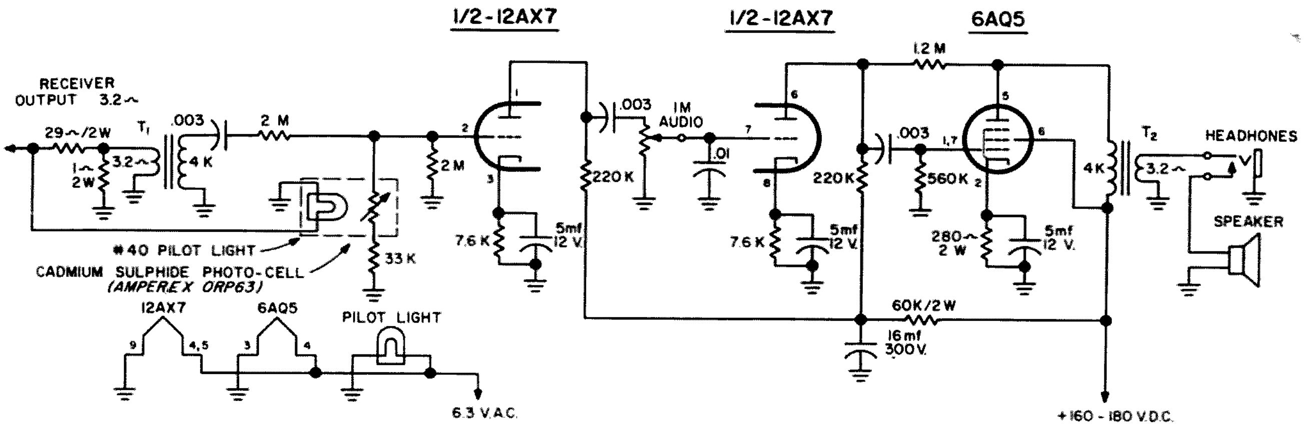
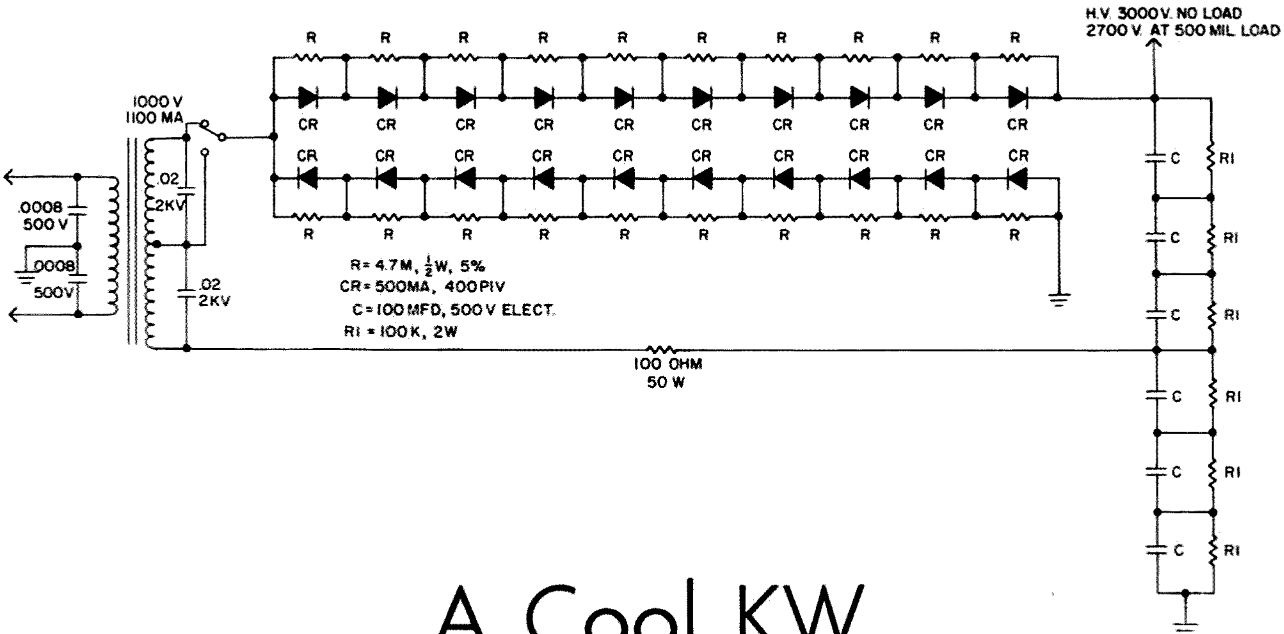


FIGURE 3

circuit works well though it necessitates modifications to the receiver and gives only one level of constant gain. Signals below that level will vary widely. After a little thought, I realized that a separate audio system would have to be used. The only modification to the receiver is the disconnection of the speaker. The circuit is shown in Fig. 3. The circuit is a standard audio amplifier except for the first stage. The first stage is controlled by the photocell-bulb combo. The number 40 bulb is connected to the input of T2. A signal is applied and the bulb's intensity varies at almost an audio rate. The decay rate of the filament provides an averaging effect. The averaging effect allows the output to vary with the amplitude rate of the signal instead of the syllabic rate of speech. The resistance of PC1 varies as the audio signal strength varies. PC1 now acts like a volume control shunting more signal to ground as the signal increases and less signal to ground as the signal decreases. This then provides a fairly constant level to the manually variable gain control R1. This constant level can be set to any higher or lower level the operator desires.

The unit is built into a 5 × 6 × 4 aluminum utility case. A chassis was bent from some spare aluminum. T2 and T3 are cheap plate to voice coil transformers with a 4K primary. Standard audio layout is used. A neon bulb pilot light connected to the B plus was used; but a standard 6 volt pilot light connected to the filament may also be used. A B plus voltage of 160 to 180 volts at 30 ma is needed. This can be stolen from the receiver or from an external supply. The photocell is taped so that the sensitive face is parallel to the long side of the bulb's filament. Operation is simple. Set the receiver audio gain so that most signals are limited in gain by the first stage, V_{1A}. This can be checked by placing a VTVM across the output of V_{1A} and checking for a constant voltage as the receiver audio gain is increased. If a VTVM is not available, just listening to the output will suffice. Once the minimum signal is set by the receiver audio gain, this control is no longer used. The volume control, R1, is now used to provide any volume level needed with a fairly constant level at any setting.

. . . Pullman



A Cool KW

Perry Thomas K5YWJ
P. O. Box 367
Silverton, Texas

Even a ham does not get "something for nothing" anymore, but this kw power supply is next to it! Compared to the cost of a conventional supply, you can have money left over for a new hat for the XYL, new shoes for the baby and cold 807's for the OM!

The transformer, about 1000 volts, at 500 ma or more, can be easily found on the surplus market. Mine is 1000 volts at 1.1 amps; Pacific Transformers #20046, from a radar power supply. Caution: do not go much above the 1000 volts across the secondary or you will end up with an embarrassingly high voltage and blown filters.

The schematic is a standard voltage doubler circuit using Silicon Diodes and high capacity filter. This shows an odd ripple pattern on a scope, but I have used it on my 813's in grounded grid ala G. E. Ham News for over two years of SSB AM and CW operating, driving it with the Apache-SB10 at first and now with the HT-37, and have had no complaints of hum. Nor have I had a single component failure in the power supply.

The diodes are Sarkes-Trazian M-500's, but 750 mil top hats are cheaper.The shunt resistors on the diodes should be 5% tolerance because they act as a constant load balance on the diodes and keep the diodes from blowing when operated at full rating.

To figure the diodes and capacitors for a transformer of different voltage, since this circuit almost triples the rms of the secondary, each leg of diodes and filter capacitors should be rated 1½ times the secondary voltage, or slightly more for a safety factor; raising the resistance of the surge resistor gives a little better regulation with a corresponding drop in output voltage. My supply delivers 3000 volts with no load and 2750 volts at 500 mil load, which is as good as most conventional supplies.

The center tap is used to give reduced power for tune-up. This really is not necessary on 813's but is an essential for some of the other tubes that may be used. I use a SPDT switch rated at 10A-250 volts here and have no trouble hot-switching it.

I hope you are as satisfied with the supply you build as I am with mine—I will never use 866's again.

. . . K5YWJ

Especially as used in a low-noise transistor converter

Larry Levy WA2INM/1
Marlboro, Vermont

2m Beer Can Cavities

(Teetotalers may use soft drink cans)

The subject of resonant cavities seems to be surrounded by an air of mystery and confusion. They are things that are used by people who work UHF and microwaves and seem to have found little use in the VHF field. One reason for this is that few amateurs seem to fully understand what they are, exactly what they do, their construction, and their applications. I will attempt to simplify the subject and show what the practical applications for cavities at the VHF frequencies are.

Cavities are basically an infinite number of shorted quarter-wave tuned stubs in parallel. They take the configuration of a cylinder with a rod in the center, with one end shorted and the other end tuned by a capacitor. If you will try to forget your mental picture of expensive-looking silver-plated plumbing for a moment, try to imagine a shorted quarter wave stub. Now connect another one in parallel. Now add more until you have a circle of them so that the last one added is touching the first. You will have a can with a rod in the center, which is precisely what a cavity is. Proceeding on this assumption, and also the assumption that you don't want to spend many dollars for the silver plated variety, I will show how they can be made very inexpensively.

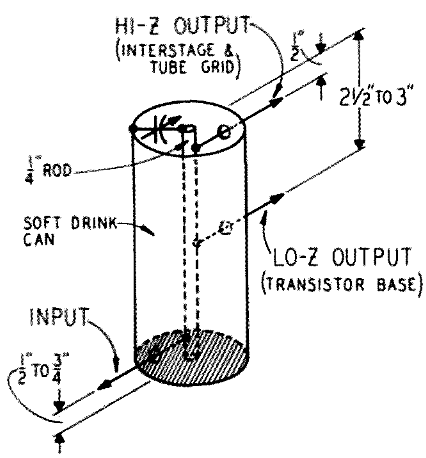


Fig. 1. Basic cavity.

The cavity has many advantages over a conventional tuned circuit. It has a very high Q and low loss. By substituting the front end tuned circuits of a converter with a cavity, the selectivity can be improved to the point that no additional selectivity is needed to eliminate images and spurious responses that are less than a megacycle from the desired frequency. Two cavities are needed, not to get a narrow enough bandwidth, but to get a wide enough bandpass to be practical. Image rejection of better than 60 db is easily obtainable for signals removed by 1 mc from a 2 mc bandpass at 2 meters. By adding one or two more cavities, rejection of better than 100 db is possible. This means that it is not necessary to use double conversion or a high *if* to get desired selectivity. With the use of cavities tuned for a 1 mc bandpass, it is possible to use the BC band *if* with few problems. This should make construction of mobile converters easier.

Cavities have a very high Q and low loss, as I mentioned earlier. Aside from the advantage of image rejection, this can noticeably improve the effective sensitivity of many low noise converters. Because of the high voltage gain, the s/n ratio of an amplifier is better. There is a fixed amount of noise at the grid of a tube. The more voltage that is applied to that grid, the more the signal will be out of the noise. The Q of a cavity effectively raises the voltage of a signal. When used to feed an amplifier, this means that a signal is amplified without the addition of any noise, as the same signal is driving the grid of the tube with more voltage compared to the tube noise, in comparison with the voltage that the same signal would deliver with a conventional tuned circuit. On a margin-

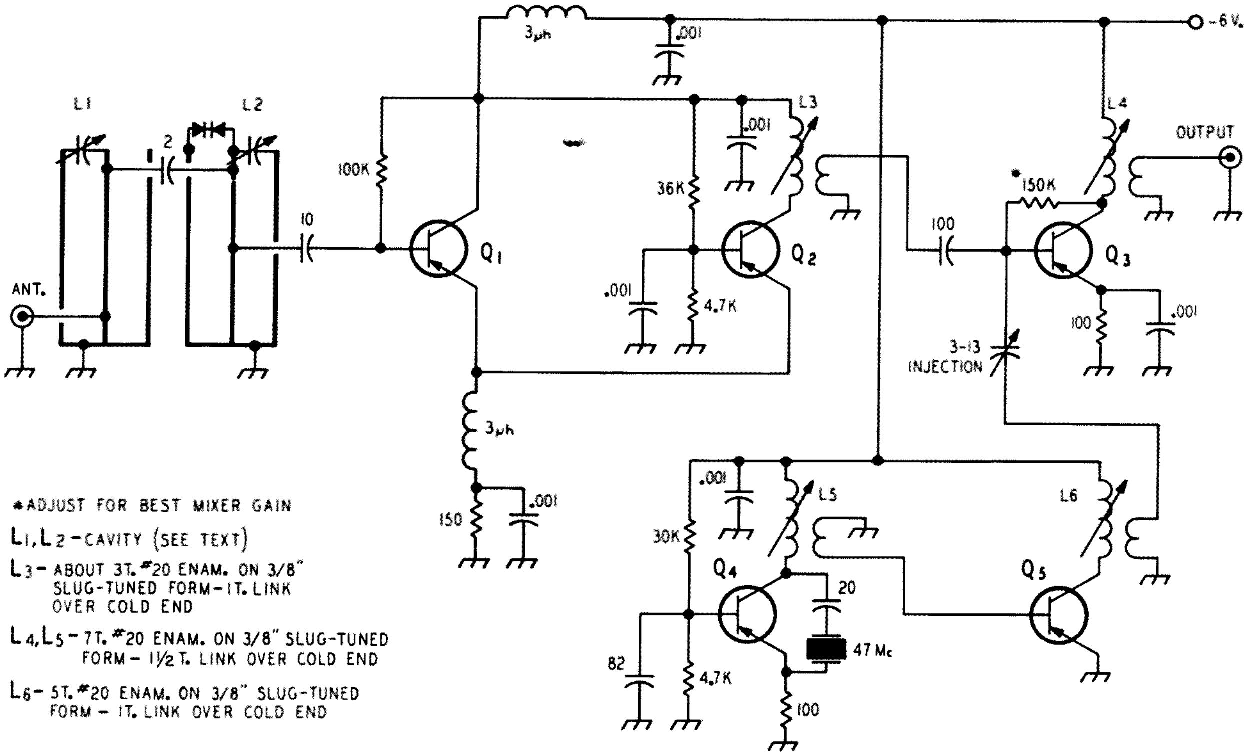


Fig. 2. Low-noise two meter transistor converter. Q1 and Q2 are 2N2360, 2N1742, 2N2495, etc. Q3, Q4 and Q5 are VHF transistors such as 2N2084, 2N1743, etc.

al signal, this means the difference between Q5 copy and no copy.

Getting back to construction of cavities, I mentioned before that a cavity is nothing more than a glorified can with a rod in the center. So why not use a can with a rod in the center? The tin plated soft drink cans (12 oz.) are just about the right size for a two meter cavity. They are easy to solder to and are easily available. The rod can be a length of copper tubing of about ⅛" or ¼" diameter, available from auto supply stores. The rod is soldered to the bottom of the can in the center. Holes are drilled for the proper taps in the side of the can. The cavity is tuned with a ceramic trimmer of about 5-20 pf for the two meter version. A six meter cavity can be made by soldering two cans together after removing the bottom of one can, and tuning it with a 7-45 pf trimmer. The taps should be twice the distances given for the two meter cavity as impedance depends on distance relative to overall length. Some experimenting with the taps will produce an optimum point. Average distances are given as a starting point, and will work quite well, but each cavity should be adjusted for best s/n ratio. **Fig.** 1 shows the basic construction.

As for practical applications, **Fig.** 2 shows a transistorized two meter converter that can be built using cavity input. Transistor Q1 is an emitter follower and is used to match the impedance to the grounded base amplifier, Q2. The emitter-coupled circuit has a small amount of loss because of slight impedance mismatch, but it is low enough to be negligible, and the direct coupling makes up for some of the losses found in coupling networks. The circuit shown is capable of a sensitivity of better than .1 microvolt for a readable signal. I have not actually built the converter as shown, but have on separate occasions built both the two transistor preamp and a two meter converter using this basic design and there is no reason why the two combined shouldn't work as well or better than the separate circuits. The cavity preamp was built exactly as shown and the output is taken from point X, in case someone would like to build a preamp alone. The converter is the same as one that I built using conventional tuned circuits, except that the rf amplifier is replaced by the cavity/Q1-Q2 combination. The *if* output of 50 mc was chosen to work into a six meter converter for mobile use. With the use of cavities, the *if* could be changed to any frequency from six meters down to the broadcast band by just changing the crystal, and L4, 5, and 6 to the correct frequency. Two diodes, wired back to back are used to protect the transistors from strong signals. Any small general purpose diodes with a very low PIV will work. Don't underestimate the voltage gain of a cavity. The Q can run anywhere from 50 up into the thousands, depending upon the load-

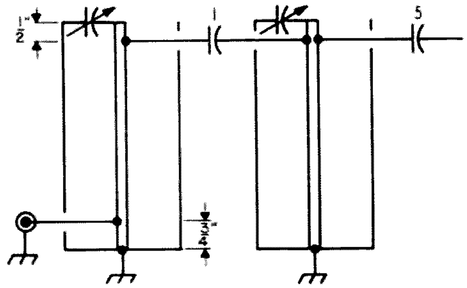


Fig. 3a. Connection for tube grid.

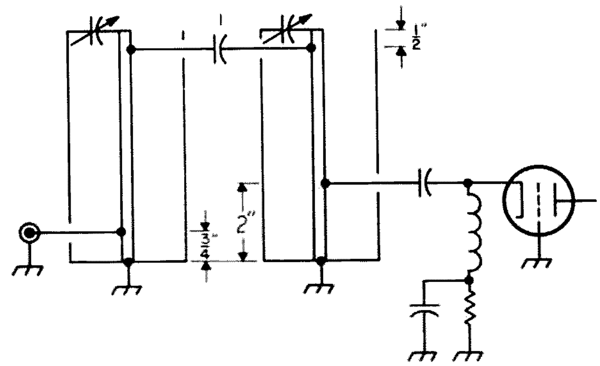


Fig. 3b. Grounded grid input.

ing. With a Q of 1000, 10 millivolts input can give up to 10 volts output, or enough to destroy the base-emitter junction of a transistor. Think about that for a second. 10 millivolts isn't much when you consider the leakage of an antenna relay at this frequency. When the diode breaks down, it loads the cavity so that the Q, and the voltage gain, drops to a very low value. This should happen before the base-emitter junction breaks down as the diodes are at a higher impedance, therefore a higher voltage point.

The loss can be reduced more by using a glass piston trimmed instead of a ceramic trimmer. Just drill a hole by the top of the cavity and mount it. A BNC connector can be mounted on the cavity for the input, if desired. By connecting a 5-50 pf trimmer to point Y, it may be possible to obtain a better match. This will have to be determined experimentally for each cavity.

Fig. 3 shows how the cavities are used for tube circuits. **Fig.** 3a is for a grounded cathode or cascode amplifier. **Fig.** 3b is for a grounded grid. I think that the best advantage of the cavities is in the front end of a cascode, as most advantage can be taken of the voltage gain. The difference is slight, however, if care is taken to match impedances carefully and reduce loading.

The cavities for any of these circuits are bandpass tuned for the desired portion of the band. It is possible to stretch about 2 mc at two meters by careful adjustment. They are bandpassed by conventional tuning procedures. The tuning is quite critical, however, and must be done more carefully, as a small fraction of a degree of rotation can detune the cavity a considerable amount, so proceed slowly. The piston trimmers have the advantage of finer control.

The physical mounting of the cavities are easily accomplished by the use of small copper straps. The outside of the can is cold for rf and can be grounded at almost any point or points. The simplest way is to mount the can on its side and strap it to the chassis at both ends, making doubly sure to make good contact. Mounted this way, they take up little space.

I hope that I have cleared up some of the mystery of cavities for you. It would be nice to see more hams taking advantage of the benefits of cavities, and saving money by not having to buy that gold-plated converter that you were going to mortgage the shack to buy, in order to gain ½ db. Spend the money on a better beam instead, and improve your transmitted signal, and you will be better off. Get out your can opener and good luck.

. . . WA2INM/1

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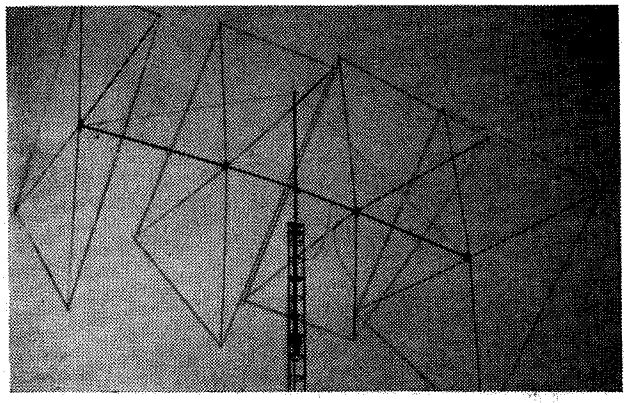
The 4-element Rhombus

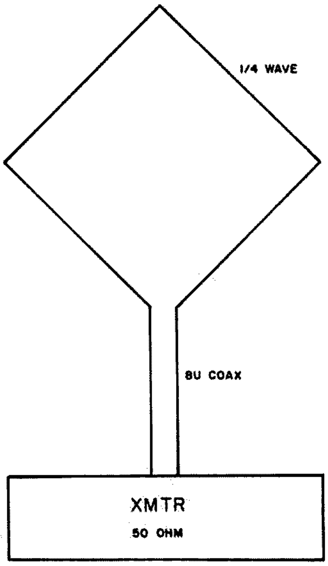
An antenna's gain is determined primarily by its configuration. For example, a two element parasitic beam characteristically exhibits about a 4-5 db gain over the usual dipole standard. It will give only 4-5 db, and no alteration to the feed point or spacing will materially increase the gain. A third element properly spaced will add some gain. However, diminishing returns reduce the amount of gain to a smaller percentage than when the second element was added to the driven dipole. Consequently, a practical point is reached where the yagi array supplies the greatest benefit, and further element additions produce an extremely cumbersome system without corresponding increase in gain. The normal yagi is therefore 3-4 elements on a 16-20′ boom with a gain of about 5-8 db.

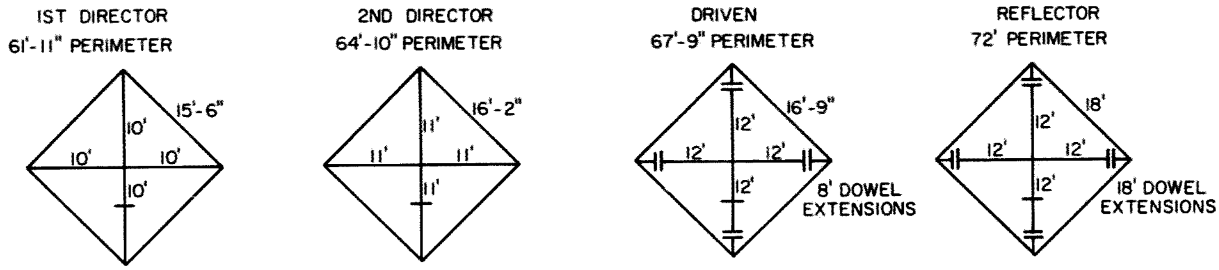
For increased gain above a well tuned yagi, the amateur must turn to a different array for 9-13 db gain.

The rhombic antenna several wavelengths long is acknowledged to be a desirable antenna. It has superior radiation and gain qualities. With this in mind, it was decided that a rhombus (one wavelength in periphery) in a vertical plane coupled parasitically to three similar units properly spaced and tuned would produce an outstanding signal. The large area within the closed loop intercepts a greater portion of the radiated magnetic field thereby sampling more signal. Since the antenna's receiving quality is directly proportional to the gain, it follows that the antenna will radiate a great amount of rf energy. For the low vertical angle of radiation, the feed point remains at the lower apex of the rhombic. The normal resistive terminations are deleted. Since the maximum field of radiation is perpendicular



4-element rhombus.





Dimensions of rhombus.

o the plane of the array with insignificant minor lobes, it is ideally suited to the rotatable installation. On the air tests have shown the front-to-side ratio to be 30-40 db.

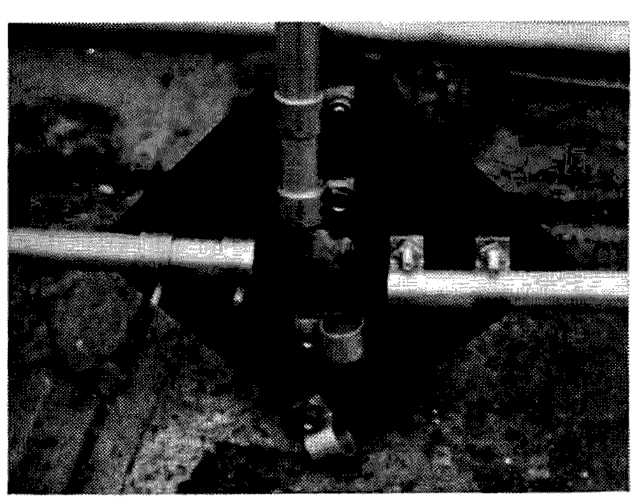
The entire unit is home-brew and utilizes aluminum spreaders for strength and durability with no detectable sacrifice to antenna input characteristics. Contrary to popular belief, signals were not spuriously radiated or absorbed due to the aluminum cross arms. Tests were made by a local amateur (WA2KQZ) residing several blocks away for harmonic indications (within the range of a 75A4 receiver) and none were detected. The antenna reflected zero reactance when coupled to various measuring devices and exhibited a near perfect resistive termination. Since maximum signal transfer was of prime importance, the unit was designed for one band only. Compromise SWR was not to be tolerated since no multiband antenna performs as well as an antenna designed for one-band operation.

Construction

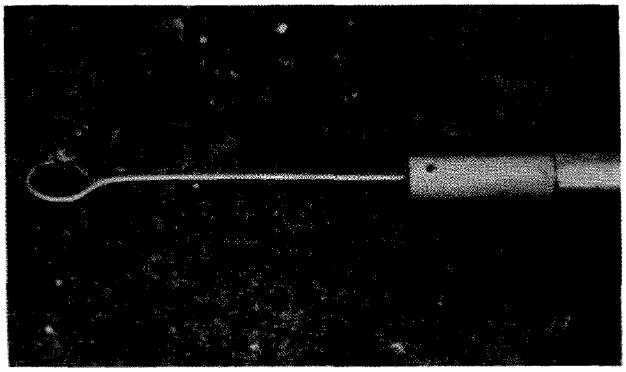
A boom length of 30′ worked well and netted a spacing of 10′; however, 8′ between elements will exhibit properties of similar value with a somewhat lower input impedance and gain factor. Should a perfect 50 ohm terminus outweight the desire for maximum gain, driven element spacing with respect to the reflector element could be attempted. Anticipate lower gain but receive a better transmission line-antenna match with the smaller spacing due to the closer parasitic element coupling effects.

The spider units were built around four 2×12″ squares of ¾″ plywood preserved in creosote solution. Four aluminum 1¼″ pipe flanges with set screws provided spider-boom securement. Holes equal in diameter to the flange openings were drilled in two spider units to facilitate placement on the boom. Eight tubing clamps were positioned on each plywood square so that the aluminum spreaders would be properly oriented and perpendicular to each other. A 12′ length of ⅞″ tubing 0.058″ wall was chosen for each upper mast vertical spreader support since the greatest stress was upon this unit. A 6′ length of ⅞″ tubing was chosen for the lower vertical portion. An additional 6′ length of ¾″ tubing 0.058″ wall was telescoped several inches into the larger unit for ease of construction. The two horizontal and one vertical (upper) portion of the four systems were assembled at roof level and then raised to 6′ with the tower or supporting structure. While still within arm's reach, the 6′ length of ⅞″ tubing was installed into each spider unit and secured. The antenna was then raised another 6′ and the length of ¾″ tubing installed by telescoping into the larger unit. A 1″ hose clamp completed the mechanical bond. This telescoping flexibility will be particularly welcomed by those with no tilt-over tower of long extension ladder facilities.

In order to insulate the #14 formvar coated copper wire from the aluminum, dowels were cut, boiled in paraffin to increase their insulating quality, and installed into each spreader end. The ⅞″ and ¾″ tubing requires ¾″ and ⅝″ dowel respectively. Screw-in TV type insulators were installed in each dowel which not only provided isolation but assisted

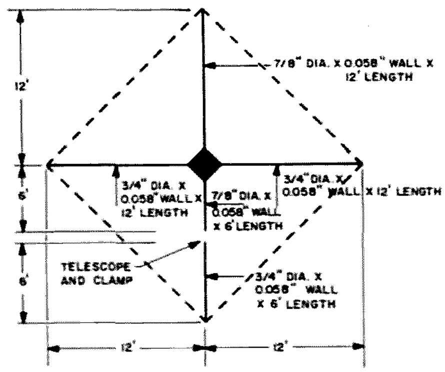


Details of center support.



Detail of spreader.

TUBING SIZE LAYOUT



in subsequent adjustments of spreader breadth. Where the formvar wire passed through the standoffs, a length of polystyrene 8U insulator was slipped over the wire. The inner conductor insulator not only provided additional isolation, but tended to soften the corner angles thereby reducing radiation loss due to the otherwise sharp bend angles. After final adjustment, each standoff was squeezed closed with a plier and further movement was prevented.

Rather than measure each rhombus leg individually, four separate lengths of twine were cut which corresponded to one side of the four antenna elements. This aided immeasurably when leg lengths were being determined. One end of the twine was placed at the uppermost vertical support and the other end swung in a pendulum-like motion. Each leg was adjusted and pulled taut using the premeasured string as the reference. Error was kept to a minimum. The screw-in standoffs were adjusted slightly to provide the proper length and tension and insured a true geometric figure. Balance was the key to the proper design and careful attention was given to the symmetry of the array.

The rhombus is a balanced system electrically and the transmission line should also boast balanced properties; however, coaxial cable, inherently unbalanced and not ideally suited to this installation, was used with no negligible loss. Simply solder the center conductor and shield to the two antenna wire terminations at the lower apex angle and coat the connections with liquid polystyrene. Dampness will have less effect on the loading.

The antenna reflected about 60-65 ohms when at roof level and varied slightly when raised to the operating height. This tended to indicate that the array was suitable to installations where height cannot be easily attained. Many apartment house and limited space dwellers could easily rotate the system several feet above the roof level with little sacrifice to radiation input characteristics; however, for the low angle of radiation and maximum signal projection a height of 60′ and more is necessary. Although polarization shifts when reflected from the ionized layers, the initial low vertical angle of radiation provides the slight edge over the standard horizontally polarized quad array of comparable design. For line-of-sight transmissions (to a horizontal array) cancellation affects due to cross polarization are evident, but the DX signal losses are infinitesimal and are of no concern.

The dimensions given are to resonate the antenna system at the 14.270 MC mark. For operation in the CW portion of the spectrum, add one foot to the perimeter thereby lowering the resonant frequency. Insure that equal increments are also added to the other elements to maintain inductive and capacitance reactance balances. The "Q" or bandwidth of the system is reasonably low and will allow for operation over the entire amateur portion of 20 meters, but losses can be expected with major movements away from the resonant frequency. An SWR bridge will indicate the tolerances within which one's transmitter will properly perform.

. . . K2IRK

Parts List

6 12′ lengths ⅞″ 0.058″ wall tubing
10 12′ lengths ¾″ 0.058″ wall tubing
4 1¼″ pipe flanges (aluminum)
16 ⅞″ aluminum clamps
16 ¾″ aluminum clamps
4 12 x 12″ ¾″ plywood (creosote soaked)
4 spools #14 magnet wire (heavy formvar insulation)
16 7″ standoff insulators (screw-in)
4 length of ¾″ dowel
12 Lengths of ⅝″ dowel
4 aircraft hose clamps ¾″
32 ¼ x 3″ bolts
32 ¼″ nuts
32 lock washers

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A Power Decade Resistor

As most technicians and hams are all too well aware, the average resistor decade or substitution box is only rated for a few watts power dissipation at most. Usually the place where one needs the adjustable feature of the decade box the most is just the application where the power rating of the device is vastly exceeded. This was brought to my attention one day when a fellow student cooked a General Radio decade resistor while adjusting a voltage divider in a laboratory experiment at school. I decided that I needed a power decade resistor, and since these are rare and quite expensive, I decided to homebrew it.

One of the most common methods of constructing decade resistors is to use resistances of 1, 2, 3 and 4. With these four values, one can obtain any value between 1 and 10. Usually a special rotary switch such as that made by Mallory (or a special connection of a standard 11 position double pole rotary switch) is used to select the desired resistances. Rotary switches, however, are not too well suited for power application, because of their limited current carrying capacity. Therefore the simple circuit in Fig. 1 using toggle switches was put together.

Note that the resistors are all in series, in the natural order 1, 2, 3, 4 and that each resistor has a SPST toggle switch in parallel with it. With all the switches closed, the resistance is zero; to put a particular resistance in the circuit, one merely opens the switch in parallel with that resistor. The desired value of resistance is made up by adding the various values up until the desired total is reached. It should be remembered that in a series network, the voltage across (and therefore the power dissipated by) any particular resistor is proportional to its resistance. If you have a 10 ohm and a 20 ohm resistor, each rated at 10 watts, in series and try to dissipate 20 watts in the combination, you will find that you are actually dissipating 13.3 watts in the 20 ohm resistor and 6.7 watts in the 10 ohm resistor. Obviously the 20 ohm resistor is overloaded. The use of toggle switches solves the problem of the switch contact current rating, and makes the wiring of the unit simple as well. The cost of the unit using toggle switches is cheaper than that of the unit using rotary switches.

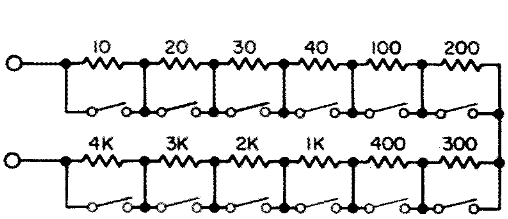

Fig. 1. Schematic diagram of power decade resistor.

A decade box using three decades and adjustable from 10 ohms to 11,100 ohms in 10 ohm steps was constructed in a standard 5 × 10 × 3 aluminum chassis. The units which I made all used 10 watt resistors, but there is no reason why one cannot use any size desired. If you use 10 watt resistors, the cheapest seem to be the PW series made by IRC. While these have a nominal tolerance of 10%, I have found very few that are off more than 5%. For short term use it was not found necessary to drill ventilation holes in the chassis. If hard use of the box was foreseen, or if it were constructed for a higher wattage rating, then ventilation would be a must. This method is also useful for making standard resistance decades using precision resistors, but it is often cheaper to buy these ready made, unless you have a supply of precision resistors of the proper values. A similar method may be used to make a capacitor decade box, by placing all the capacitors in parallel, and putting the switches in series with the capacitors. In this layout, the switch is closed to select a particular capacitor.

. . . Lyman

Is your GDO too touchy?
Fix it!

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Improving The Grid Dip Meter

One of the most useful items in any ham shack is a grid-dip oscillator, usually called either a grid-dip meter or simply a dipper.

Many versions of this handy little device are available in either kit or ready-wired form; all work well, some better than others. However, many of the less expensive ones share one common disadvantage—difficulty in keeping the meter needle on-scale at the lower frequencies.

This comes about because the oscillator must be extremely active to get any kind of meter indication at the UHF end of the range, which results in so much grid current at the lower frequencies that the "sensitivity" control's effect is greatly magnified.

In my dipper, the result was almost complete inability to keep the needle on-scale when using either the A, B, C, or D coils. It was even a problem with the 42-100 mc coil; the only place I didn't have this trouble was on the 100-200 mc band!

However, for 15 cents and a few minutes' time, the problem can be completely removed. The modified dipper can give an off-scale reading still, but the "sensitivity" control moves it smoothly back to the top of the dial. All who have used it agree that the modification is well worth the effort—which is actually so small as to make that statement a sort of left-handed compliment!

Though the description which follows applies specifically to my dipper, the modification is applicable to any GDO whose meter circuit resembles Fig. 1.

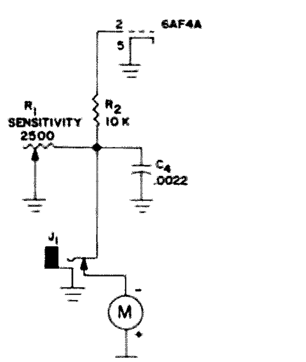

FIG. 1 ORIGINAL CIRCUIT

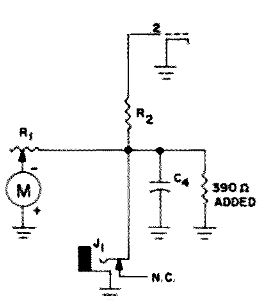

FIG. 2 MODIFIED CIRCUIT

A glance shows the reason for the difficulty. The meter itself is a 500 microamp movement, connected through the phone jack from the bottom of the grid-leak to ground. The "sensitivity" control is simply a variable shunt for the meter. When grid current is 500 microamps or less, the sensitivity control is turned to its full-resistance position and effectively is out of the circuit. But when grid current is higher than this, the 2500 ohm pot must be cranked down to shunt the meter.

The amount of shunt resistance required on the lower ranges is somewhere near 100 ohms in most cases; trying to set a 2500 ohm pot to 100 ohms with any degree of accuracy is almost impossible, since the resistance of the pot changes some 8 ohms for each *degree* of movement, and the hand is unable to move the knob much less than 5 or 10 degrees at a time. The result is the familiar inability to set the needle; the meter jumps from zero to off-scale with almost imperceptible movement of the control.

However, if the arm of the pot is lifted from ground and connected to the negative meter terminal, breaking the connection from the meter to the phone jack in the process, and a low-value resistor is added from the top of the pot to ground as shown in Fig. 2, the circuit becomes somewhat different.

Now the grid current develops a voltage across the new resistor, and the pot-meter combination becomes a variable-scale voltmeter. Sensitivity of the voltmeter varies directly with pot movement.

My dipper develops a maximum of about 2½ ma of grid current on its lowest band. The combination of the 500 microamp meter and the 2500 ohm pot forms a voltmeter which reads full-scale with 1.25 volts input, if the pot is set for maximum resistance. These voltage and current values, in turn, prescribe the maximum value for our added resistor. To

just be capable of full-scale readings, the added resistor cannot exceed 500 ohms in value.

To leave some margin for tube aging, etc., I chose to use a 390 ohm resistor. This will allow a reading of 390 microamps on the meter if the pot is set for maximum resistance, and this will be the *lowest* reading you can get at this point with the modified meter. Reducing the pot resistance to 1,950 ohms gives you an exact full-scale reading.

On the UHF bands, turning the pot to minimum resistance will effectively remove it from the circuit, leaving you simply the 500 microamp meter shunted by a 390 ohm resistor. While 390 ohms is a whale of a lot less than 2500 ohms, the effect turned out to be negligible here; readings were reduced less than 5 scale divisions on the meter, and it was still a cinch to read the unit.

If you'd like to make a second modification while you have the case off, here's one which has nothing at all to do with the operating convenience but can help protect your meter movement if you carry the instrument around a lot.

This change involves replacing the SPST "power" slide switch with a DPDT switch of similar construction and size, and using the added pole to short out the meter when the power is off.

Any D'Arsonval movement will tend to "kick around" quite a bit with vibration, and a sensitive meter such as used in this unit is especially subject to getting knocked off its bearings by any extreme shock.

However, if the meter terminals are shorted together, the movement of the needle with vibration is almost completely damped out. This comes about because if the needle moves, the coil in the meter generates a small voltage (it's just a small generator in reverse). When the terminals are shorted, this voltage is immediately applied back to the meter, freezing it in position at zero.

The change is as simple as the previous one: Remove case, take out power switch, and disconnect both wires. Connect them to new DPDT switch, using corresponding terminals. Connect two new wires to the other pole of the switch, using the terminals toward the opposite end of the switch. Reinstall switch, and connect one of the new wires to each terminal of the meter. To check for proper wiring, turn power switch "off" and shake meter. If needle moves, check your connections—it shouldn't budge a fraction. If it stays put, slide switch to "on" and shake gently again. Meter should now gyrate wildly.

. . . K5JKX

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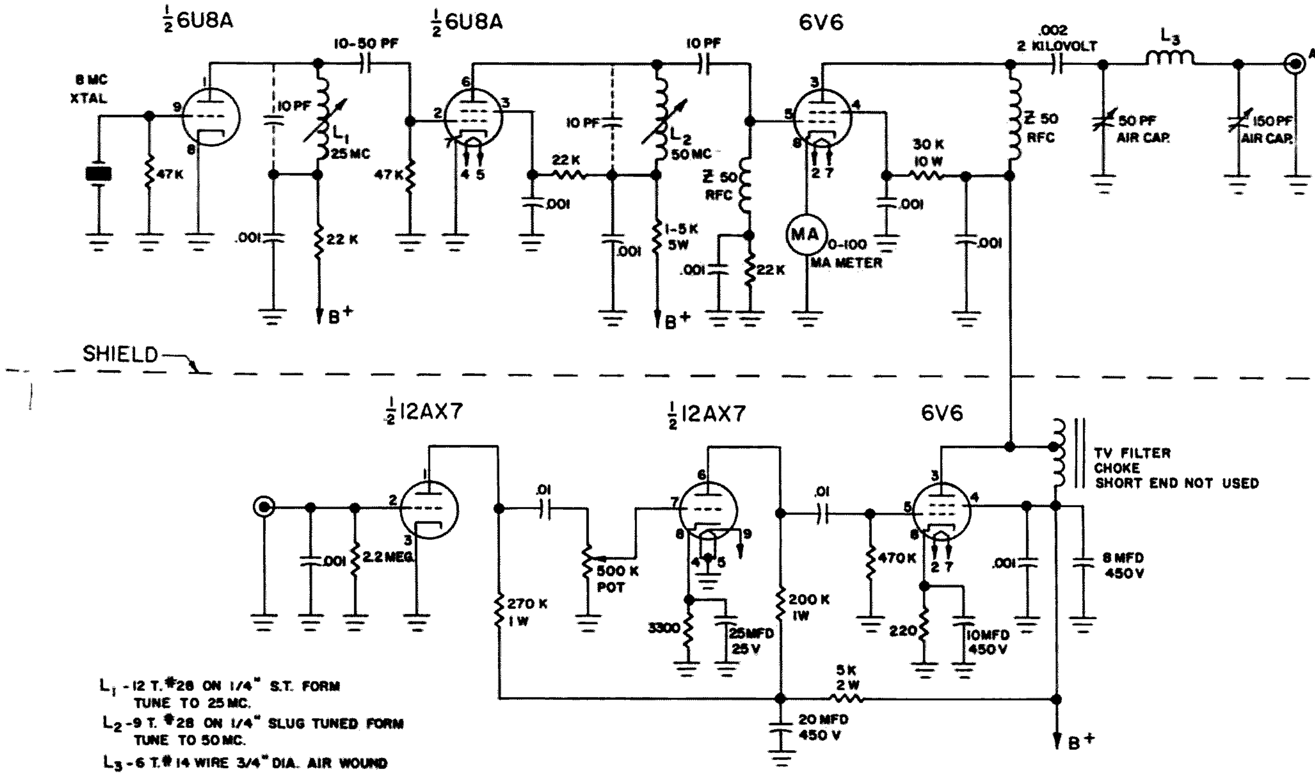
One More 6 Meter Junk Box Rig

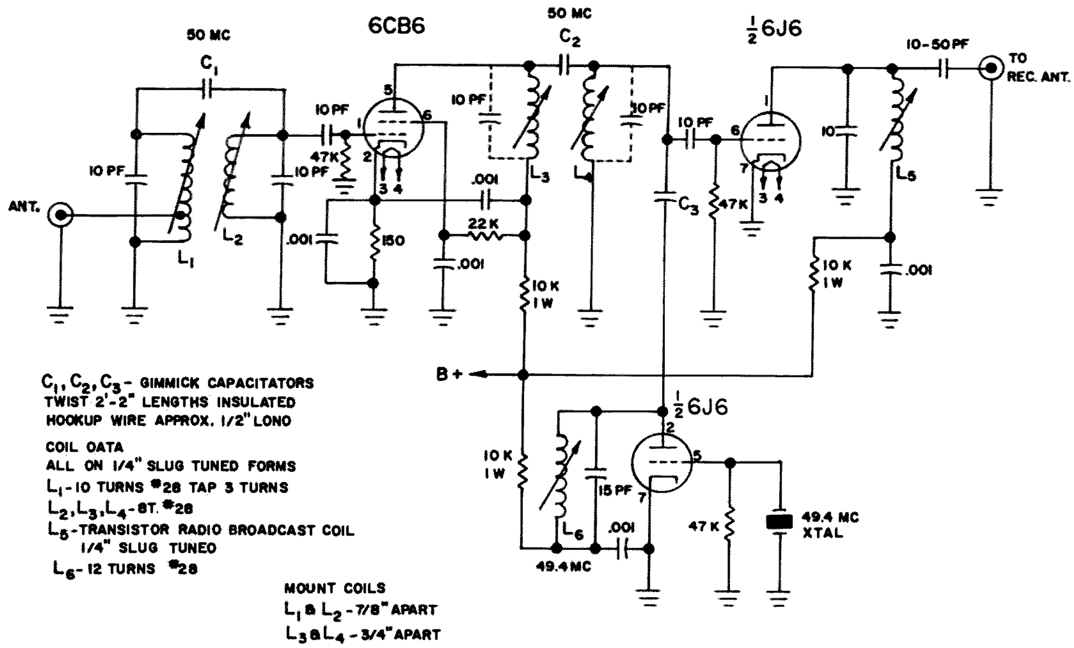
Perhaps my junk-box is better stocked than some (most of my parts come from junked TV sets and 6 volt auto radios), but this little rig required a cash outlay of under seven dollars for the missing parts. With a little trading I might have cut it down further. The biggest outlay was $4.50 for the crystal for the receiver converter. The west coast boys are a little more fortunate with their plentiful supply of military surplus gear, but we make do with old TV sets.

The transmitter could be called a "Glorified Sixer", running about 18 watts input into a 6V6. This tube was chosen as a final because most car radios from the junk yards happen to have two of them in the line-up. The 6U8 oscillator and doubler came from a TV set, as did the 12AX7, the slug-tuned coil forms, sockets, resistors, condensers, and the modulation transformer. A word about the transformer—in the original version of this rig, I tried a push-pull audio transformer as described in several schematics, and had my share of troubles trying to get enough audio to modulate the rig. I finally used the filter choke from a TV set and now have audio gain to spare.

Lay out your parts so that all leads can be kept as short as possible. Another point: isolate the modulator section from the oscillator and final. The rule is "shield until it hurts." This complete rig, less power supply, was built in a box 5x7x6 inches high, starting on a 2x5x7 inch chassis. The modulator was kept away on one end of the chassis, and the underside has an aluminum shield 2x5 inches separating the modulator wiring and sockets from the oscillator and final. If good construction practices are observed you shouldn't have any difficulty.



6 METER CONVERTER TO BROADCAST BAND RECEIVER



It is a good idea to check all the slug-tuned coils with a grid-dip meter to get them somewhere near frequency before they are installed in the chassis. Give them another check and adjustment after the wiring is completed and tubes are in the sockets, with the *power off*. If you don't have a GDO, you probably know a ham friend who will be more than glad to give you a hand.

The receiver is a 6 volt auto radio, converted to 110 ac operation, with a converter in front of it. The conversion to ac is simple—pull the vibrator out and discard it. Now you have a choice. You can either retain the power transformer in the set, and feed *one half* of the primary winding with 6 volts ac (if you are using a 6 volt set) at about 5 or 6 amperes. An old train transformer will work here, if it has the current capabilities. Another source is the 6 volt winding from a TV power transformer. If you have the schematic of the set, you're in business. If not, locate the primary windings which go to the vibrator socket, usually the two small pins, or to one pin and chassis. That's where you feed the 6 vac, and the set should work. Your second choice involves more work—discarding the original transformer as well as the vibrator, and building a complete power supply to feed both filaments and high voltage demands of the set. In either case, a realignment of the receiver after conversion is worthwhile.

The 6 meter converter is an accumulation of ideas, not necessarily original nor the best available, but also "cheap and it works." As is the case of the transmitter, most of the parts, including tubes, came from a junked TV set. Plenty of shielding was used between stages. My converter is housed in a 2x4x4 aluminum utility box, which doesn't leave much room to spare. A better size, to give you a little more working room, would be a 2x4x6 inch box. Coils were also tuned somewhere near frequency before they were installed in the chassis, and touched up after the final wiring and tubes were in place.

With the *if* frequency shown, your car radio will tune from 50 to 51 megacycles, which is the most popular part of the band in this locality.

If meters are a problem, just about any sort of a meter movement can be converted to 0-100 ma tuning meter for the transmitter with a proper shunt. All you're looking for is an indication, not a measurement, for loading the transmitter, and you can pick up a movement from an old tube tester, or something similar for next to nothing.

We have never worked Japan on this rig, but it does provide good communication within a 100 mile radius of the QTH, and that's all that was expected of the 6 meter band. After spending quite a few hours listening on six, it is my considered opinion that high power, and that covers anything over 50 watts input, is a waste on this particular band. This rig fills the bill. See you on six meters.

. . . K3VLQ

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The Design of Log Periodic Antennas

The performance of a lossless antenna will remain unchanged if all dimensions, in terms of electrical wavelength, are held constant. Thus, if all dimensions are decreased by a factor of τ, and the frequency is decreased by a factor $1/\tau$, the fields about the two antennas will be similar. The dimensions of the log-periodic antenna are such that the electrical properties repeat with the logarithm of the frequency. If the *n* radiating element is resonant at a frequency *f*, the next shorter element $n + 1$, is resonant at a frequency of $\tau \times$ f, where τ is the design ratio and equals $x_{(N+1)}/x$, x representing the length of the element. The frequency range from f to $\tau \times$ f is called a period of frequency and, if the variation in electrical characteristics is negligible over a period, variations can be assumed to be also negligible over the entire design range of the antenna.

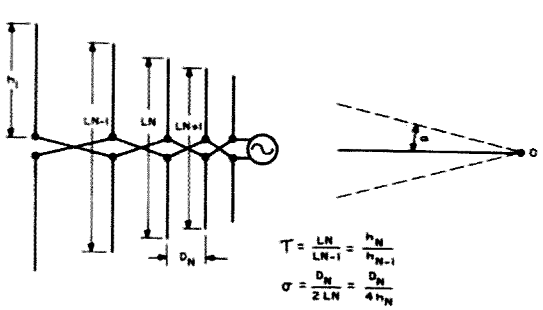


Fig. 1.

The log-periodic dipole (LPD) is an adaptation of the basic log-periodic antenna in which the "teeth" of the non-planar, wire, trapezoidal tooth structure are replaced by dipole elements and the angle between the two halves of the structure is reduced to zero. A schematic of the LPD is given in Fig. 1 showing the method of feed.

The symbols used in describing the antenna are:

α (alpha)—half the angle subtended at the vertex.

σ (sigma)—the relative spacing ratio $= d_N/2Ln$

σ'—the mean spacing factor $= \sqrt{\ \ T\ \ }$

τ (tau)—design ratio, or scale factor $= Ln/_{L1-1}$

n (subscript)—any element

n+1 (subscript)—next smaller element to "n"

a—radius of element

d_N—distance from any element to next smaller element

x—Boom length between shortest and longest elements.

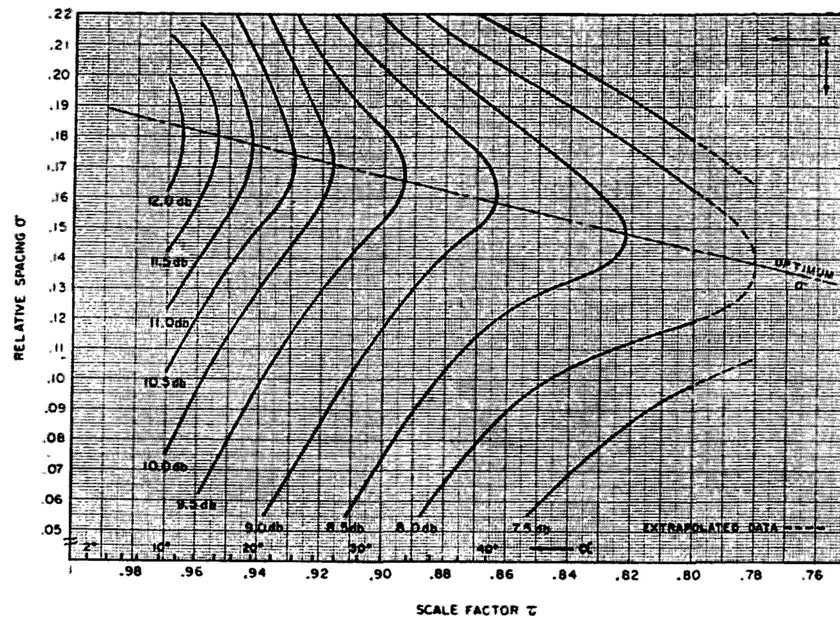
B—operating bandwidth = (max freq)/(min freq)

B_{ar}—bandwidth of the active region

h—half length of a dipole element

L—full length of a dipole element = 2h

Fig. 2.



Ro—input impedance at the front of the antenna

Za—average characteristic impedance of a dipole element $= 120(\log\epsilon \dfrac{h}{a} = 2.25)$ ohms

Zo—antenna structure feeder impedance (boom impedance) $Zo = 120 \cosh^{-1} \left(\dfrac{b}{2a}\right)$ where b = center-to-center spacing between the boom elements

It is normal to design an LPD antenna for a given gain and input impedance over a given frequency band. The relative size of the structure and the number of elements is of importance and these two factors will depend on the values of τ (an increase in τ means a greater number of elements) and α (increase in α means a decrease in size). The factors τ and σ are the main determining factors affecting the shape of the radiation pattern and there will be a value of σ, called "optimum σ" that will be an optimum for any desired gain and will give a minimum value of τ and SWR and maximum front-to-back ratio. A chart giving this relationship is shown as Fig. 2. The best design procedure is to start with the optimum value for σ and make a table for lesser values. The values for α, boom length, and number of elements, can be found from the charts given as Figs. 3 to 6.

As an example, let us design an LPD for use on 6 meters, fed by 75 ohm coax cable and giving optimum results for a maximum boom length of 10 feet.

a. Using values for optimum σ from Fig. 2 for a gain of 8.5 db $T = 0.822$; $\sigma = 0.148$.
b. From Fig. 3, $\alpha = 17.8°$
c. From Fig. 4, $B_{ar} = 1.8$; $B = 55/50 = 1.1$; $B_S = 1.98$
d. From Fig. 5, $x/\lambda_{max} = 0.38$; $\lambda_{max} = 984/f = 19.65$ feet. $x = 19.65 \times 0.38 = 7.46$ feet.
e. From Fig. 6, number of elements = 4.

A second run, using a gain of 9 db, gives a boom length of 14.2 feet.

The value of Zo is now determined to give the required value for Ro. The ratio h/a should be the same for each element, but practically the element diameters can be the same for each element, or scaled in groups and the average h/a used. Let us use ⅜" diameter tubing for the elements and, taking the value of h at 52.5 Mc, $h/a = 600$. The values of Za and σ' are then calculated and give $Za = 500$ and $\sigma' = 0.1725$. The relative feeder impedance Zo/Ro can be obtained from Fig. 7 which gives, $Za/Ro = 500/75 = 6.66$; $Zo/Ro = 1.1$; $Zo = 82.5$ ohms.

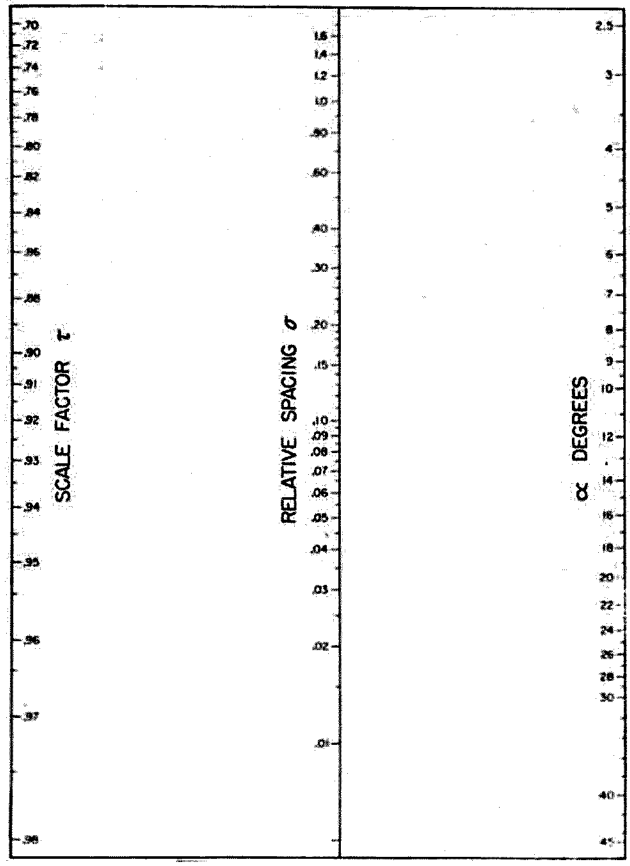
The length of the longest dipole element is given by $\lambda_{max}/4 = 58.95$ inches. The lengths of the other three elements are given from the relationship $h_{N+1} = h_N\tau$, which results in:

$h_1 = 58.95''$ $h_2 = 48.4''$
$h_3 = 39.8''$ $h_4 = 32.7''$

The distance between the elements is given by: $d_N = \sigma 4h_N$, and this gives the distances as:

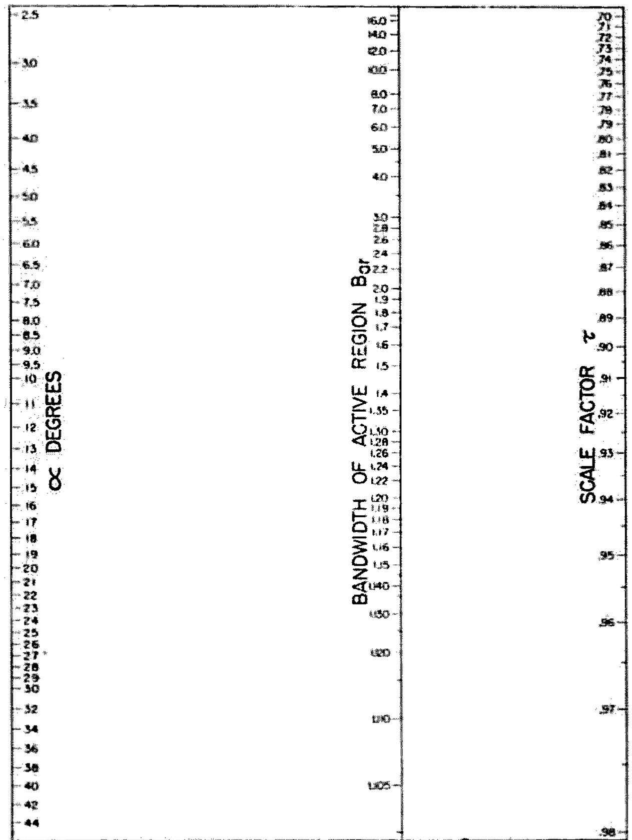
$d_1 = 34.85''$ $d_2 = 28.65''$
$d_3 = 23.55''$

Ideally, the boom elements should be conical but, in practice, two parallel cylinders can



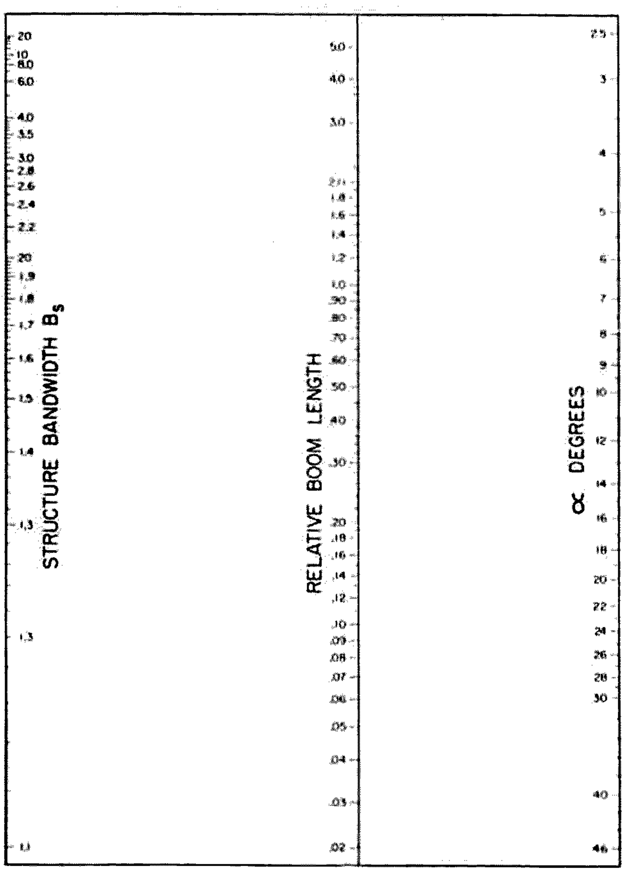
Nomograph, $\sigma = \frac{1}{4}(1 - \tau)\cot \alpha$

Fig. 3.



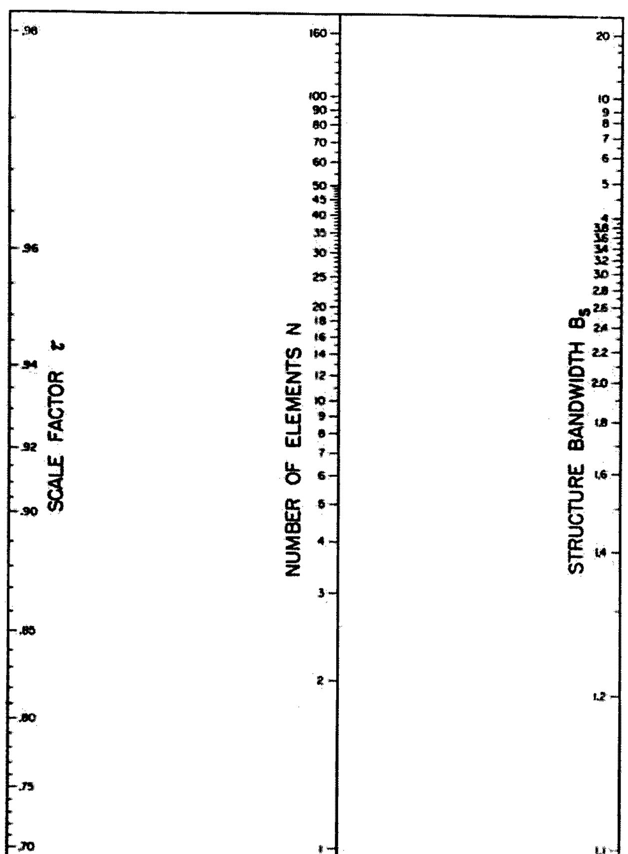
Nomograph, $B_{ar} = 1.1 + 7.7\,(1 - \tau)^2 \cot \alpha$

Fig. 4.



Nomograph, $\frac{X}{\lambda_{max}} = \frac{1}{4}(1 - \frac{1}{B_s})\cot \alpha$

Fig. 5.



Nomograph, $N = 1 + \frac{\log B_s}{\log \frac{1}{\tau}}$

Fig. 6.

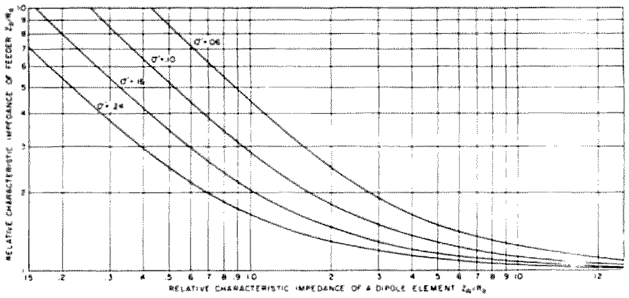


Fig. 7. Relative feeder impedence vs. relative dipole impedence.

satisfactorily replace the cones as long as the cylinder radius is small compared to the wavelength. The spacing between the two boom elements can be calculated from the formula for Zo and for our calculated value of Zo = 82.5 ohms, b/2a = 1.244 inches. This means that, using one-inch diameter tubing for the booms, a center-to-center spacing of 1.244 inches is required or the booms will be separated by a quarter inch. To keep reflections from occuring, the antenna should be terminated in its characteristic impedance (Zo). However a short-circuit across the boom elements at a distance of $h_1/2$, or less, behind the largest element will prove satisfactory. This point can be found experimentally by running a shorting bar between the boom elements until the lowest SWR is obtained on the lowest frequency in the antenna range.

The LPD may be fed in three common ways. (1) By connecting a two-wire, balanced line at the junction of the boom and the smallest element with the characteristic impedance of the line matching the input impedance Ro. (2) By connecting a balanced, two-wire line at the large end of the structure with the boom elements forming a 4:1 balun transformation. Each boom can be considered to be a coax feeder constructed by inserting a wire in the center of the boom of each structure. For use with 300 ohm line, the formula D/d = 12.25 can be used with D the inside diameter of the boom and d the outside diameter of the wire. The two inner wires are cross-connected to the outer booms at the front of the antenna. (3) A coax line, with characteristic impedance equal to the input impedance of the antenna, may be inserted through the back of one of the boom elements. The coax shield is connected to this boom and the center wire to the other boom at the front of the antenna.

Additional details on the construction of the LPD antenna can be found in the article "A Wide-band, high-gain antenna" that appeared in the Nov. '64 issue of 73 magazine.

. . . VE3AHU

Gus Browning W4BPD

Gus

Part 1

I would like to start this story by telling you that at this very moment I am setting at my typewriter in my bedroom at the home of N. Chhawna, AC5PN, in Dechencholing, Bhutan, in the High Himalyas. At this moment all ham bands are closed. But to do the story up properly I must start at the beginning of my life so that you can understand how all this business of traveling around the world just to put one of these rear countries on the ham bands so that the world's hams could get a chance to contact a "new country" got started.

I was born on Nov. 25, 1908 on a Tuesday (according to an electronic calculator in Schneider-Kreuznach in Bad Kreuznach Germany it was a Tuesday) in a small town in South Carolina. At the age of some few months my family moved to the small town of Elloree, S. C. That's where you might say I got my start—and boy what a start it was!

Ever since I was a young kid down on that poor cotton farm I have wanted to see the world. To be truthful, I never had any hopes of seeing further than maybe Orangeburg, a small city 21 miles from my old home town of Elloree. But you will see that things did happen to change all of this.

I well remember one Sunday when our old cook who had been on a visit to Orangeburg returned home and told us all about the Aeroplane that she saw. She told us that there were some folks sitting in rocking chairs on the wings and that they were rocking while the plane flew over.

Now this set my mind to wondering about the world. Just where would you be if you were to sit in one of those rocking chairs for one whole week, and the plane just kept flying all that time? I figured you might be in Arabia where all those veiled ladies were with the camel caravans coming in from across the dessert. Maybe you would be in the middle of Tanganyika with all the natives with the big spears and long ornaments hanging from their ears, or again you might be down on one of the palm covered islands in the Indian Ocean looking at the island ladies dancing under the palm trees under a big full moon! Well, I did get to all those places and a lot more, many years later on.

I can truthfully say if there were one thing I was sure of it was never seeing such sights. Even getting to Orangeburg once each year to visit the County Fair was a real adventure that we talked about many days and nights before and after each visit. I didn't think I would ever get to go to those far away places in North Carolina or down in Georgia. Things with us on the farm were very bad; then they got worse. The boll weavil that got in my dad's cotton did not help much either. But I suppose I should thank Mr. Boll Weavil because he assisted my dad in making up his mind to leave his cotton fields in South Carolina and head for that "easy money" down in Florida. He told us that there was plenty of money and oranges in Florida. Now that statement "plenty of oranges" interested us kids because if we got one orange a week in South Carolina we were lucky; of course on Christmas we always got two oranges.

Finally, we sold the farm and my father said we were moving down to Florida. There was a lot of celebrating that night, and we stayed up real late (nine o'clock) and did a lot of talking and planning.

To make this trip my dad bought a third

hand model "T," and you talk about a time! We all wanted to learn to drive that thing; it was one of those arm breaking model "Ts." My dad got it twice and my oldest brother Bud twice, and a few of our friends had an arm or two broken also. None of us had ever driven a car up to the time Dad bought this one. I remember my oldest sister Lorena and what she did to that Model T. We got it going and she drove it OK, but she forgot to put on the brakes and right through the garage she went, right on out in the plowed field, where it stalled.

Now it was my father's turn. He got it going down the road and headed in a country church yard to turn around. Church was in full swing, and somehow he forgot how to stop the thing; up the steps it went and if the church doors had not stopped him, right on in church he would have gone, all the time hollering, "Whoa, whoa, consarn it, I said whoa." After a few months of practicing, Father, Lorena and Bud did learn more or less to control that Fliver. So we started in earnest getting ready for that trip (my first DXpedition) to Florida. (At this time I was not sure whether the world was flat or round, as our school teacher said it was. It was flat to me because there was only flatness everywhere I looked.)

We packed up that fliver with 6 kids, Mom and Pop, a few chickens, Lord knows what all else, and away to Florida, the land of plenty of money and *oranges*.

Back in those days there was not a single inch of paved road between Elloree, S. C. and Orlando, Florida. It was a real American Robinson Crusoe trip all the way: lots of mud which we got stuck in many times and very few bridges. We crossed many rivers on a ferry pulled by a horse on the other side. I suppose this trip made traveling get into my blood. Well, when we got down near Orlando, Florida and started seeing those orange groves, my father, being a regular fellow, stopped any number of times and let us kind of "borrow" a gunny sack full of oranges. Boy, did we eat oranges! Even to this day I love to eat oranges by the sack full and have never got tired of them.

When we got about 5 miles northeast of Orlando, Florida, we just pulled up under a big shade tree and we pitched camp. No one seemed to mind the fact that we did not inquire who owned the land.

My father took his few hundred dollars and went looking for land. He found a nice little tract almost on the shores of Large Lake Fairview and he bought it. But his money was almost all gone, so we went to work with someone who was wrecking some houses in Orlando. Every night he brought home a big pile of that used lumber and a bucket or two of bent used nails. It was the kids' job to straighten those bent nails and to assort and stack the lumber. This kept up for a number of months until we had enough nails and lumber to build a house. My father quit work for a month and all of us pitched in and built the house. I don't think there was ever a house built in Florida any cheaper.

Well, school time finally arrived and we walked the two miles to meet the school bus to take us all to the Winter Park school. Over in Winter Park I heard about a man who was a radio amateur (at that time I had no idea what one was). His name was W. J. Lee and his call sign was 4XE. I made it my business to meet him, he turned out to be one of the nicest men I have ever met. I remember him trying to explain to me that he was one of the very first people in the world to use quartz crystals to control his transmitting frequency (Mr. Popoff excepted, of course).

At that time all this was miles over my head. In fact my knowledge of radio was zero minus; I had never heard or even seen one yet. But the bug had bitten me and I decided that I must learn more about this radio business. Somehow I got some kind of a radio magazine describing how to build a L. M. Cockiday one tube set (why I picked such a circuit I am still wondering). My problem was to get some money to buy the parts and boy, that $8.50 tube looked like a gold mine. I sold newspapers on the streets, and mowed lawns every afternoon for months and months before I scraped up enough money to order all the parts except that $8.50 tube.

I wired the radio on one of my mother's breadboards (they said breadboard and I was very careful to do just exactly what they said). I guess I checked that circuit over hundreds of times and it looked good to me.

After a few more months of scrimping and saving I had my $8.50 and ordered that tube (I think it was a WD-11). When it arrived I guess I was shaking like a leaf and in the excitement somehow the 45 volts got hooked to the 1.5 volt circuit and that tube went up with a flash. I went running in the house crying my head off saying I had blown up my tube. My father said, "Didn't I tell you not to throw away your money on that radio junk?" Well, my Aunt Polly, who was teaching school was staying with us said, "Gus, I will give you the money so you can get another tube."

Away went the money to some company up North for another tube. This time you can

be assured that those battery wires were wired up right. Of course the set didn't work, and I monkeyed with it for about 6 months before I got a signal from it. To this day I don't remember just what was wrong. But you should have seen the excitement around our house that night. The only signal I could tune in was old KDKA in Pittsburgh, Pennsylvania. My father was the first one who heard it work, and he said, "I knew Gus would make it work."

Then I became a "radio expert" and got a job working in the afternoons in a radio store in Orlando. My job was sweeping out the store every day, dusting off tubes, and later on I was instructed on how to test tubes. My salary was 25 cents per day and 50 cents on Saturdays. But I was in "Radio," that was the main thing. You know how the bug bites, and it had me good and proper.

Along about this time I met NU4ACZ, good ole Tony, and he told me all about ham radio. Now you talk about the Radio Bug nibbling on a fellow! This one really had the hammer lock on me. But old Tony told me that the first thing I had to do was to learn the code before I went any further. I went home and told the folks about this and my sister Lorena said she wanted to learn the code too because she wanted a job at Western Union. I got a door bell buzzer and made a key with an old hack saw blade, and my sister and I learned the code, though it took us six months. But we had learned Land Morse! To make matters even worse my sister had learned Land Morse but on a door buzzer! This really put me in the dog house sure enough. Tony had forgotten to tell me that there were two codes!

My mind was made up. I would learn this darn code or bust. I had by that time built a short wave receiver and by the hour I would sit with a pencil in my hand and write down a stray letter every now and then. I learned it after about a year's practice. Then, after a few more months of study, I felt like I could pass the Ham license test. After three trials I did.

I was now "one of the boys." I got an old Hartley circuit going on 40 meters, operating on a 6 volt battery and 180 volts of "B" battery with an input that was all of 6 watts. After trying out many different aerials I finally got up a ½ wave with a counterpoise and the fun really started.

I had heard Ole Tony working DX, places in Germany, Belgium, England, etc., and I had made up my mind that I could do it too. For over 6 months I had tried using an aerial and ground with no results at all, as far as working stations out of North America. But boy, when I put a counterpoise in place of the ground, I hit pay dirt! I worked stations in Europe, South America and even Australia. Their prefix was then OA, the letter O standing for Oceania and the letter A for Australia. The prefixes in those days were very simple, nothing like these new prefixes you hear now.

My Pop was an Old Timer and a kerosene lamp was good enough for him. He absolutely refused to have electricity wired to our house. I was stuck on batteries and it looked like that's all I would ever be able to use.

My brother Bud moved up to Philadelphia, Pennsylvania and he wrote me I could get a good job in radio if I came up too. I was not interested in the job; what interested me was that if I went up there I could have a transmitter operating on the ac power mains.

Have you ever tried to go from Orlando, Florida to Philadelphia with $2.50 in your pockets? Have you ever spent nights in jail while hitch hiking? One jail in North Carolina would not let me out the next morning, as the man who let me in went on vacation that same night. Here I was in a mess boys, and not the only mess I have ever been in.

MORE NEXT MONTH. Did I get out of that jail? Did I serve six months on their chain gang? Next month tells about that!

. . . Gus

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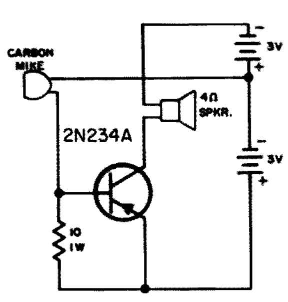
Oklahoma City, Okla.

The 73-A-Phone

Ever need to shout louder than you can? Perhaps on a DX'pedition when you were on top of the hill and your buddy was just starting up—without the chow?

Here's a device which can help you out in such a situation. We dubbed it the 73-A-Phone not so much because it's appearing in these pages as because (if you use the specified speaker or one of similar characteristics) it will produce a 73 db sound level at a distance of some 90 feet, or the same 73 db sound level inside a room 10 feet high by 15 feet wide by 20 feet deep. This 73 db is twice as much power as average conversational speech levels, so should be clearly heard.



73-A-Phone

As you can see by the schematic, there's not much to the 73-A-Phone. A carbon mike (the Western Electric F-1 button is ideal for the purpose and usually rather inexpensive unless you get caught), a 10 ohm resistor, the 2N234A transistor, and the speaker are all there is to it except the batteries. For portability these can be flashlight cells, but the larger lantern type are preferred for longer life.

While the University MIL paging speaker is recommended and is the only one I tried, any 4 ohm speaker will work with this circuit. The MIL has a self-contained horn and is a high-efficency unit, which is why it was chosen, but is admittedly a trifle expensive for such an otherwise simple device.

The transistor delivers approximately 1/3 watt in this hookup. This may not sound like very much, but if it's driving an efficent speaker it's a pretty potent package.

Many variations of this simple circuit are possible, but we don't recommend any drastic increase in supply voltages. Under no circumstances should you increase the base supply voltage above 3 volts; you're free to increase the collector supply as high as 9 volts, though, at the risk of incurring possible distortion. This, naturally, would increase power output somewhat.

With conventional speakers, this can make a most usable portable PA system for hamfest use. The batteries, transistor, and resistor can be placed inside the speaker box, leaving only the wire running to the mike button. Take care to avoid feedback in such use, though—this gadget will surprise you with its sensitivity!

. . . K5JKX

Bill Hoisington K1CLL
Peterborough, N. H.

The 1215'er

How to build (easy) a good super-heterodyne receiver that tunes from 1200 to 1300 mc using a $1 tube (better make that $2 if you insist on new brand names) and a store-bought capacitor, a hack-saw, soldering iron, and tin snips. A low cost transmitter, and 12 element yagi are also included.

Introduction

The frequency region known as UHF, 300 to 3,000 megacycles, is a fascinating place for the true experimenter, but *there are problems*! Right away on the first amateur band in it, 420 to 450 mc, techniques begin to get fussy. Circuits are described as, for example; "LI is a ¾ inch brass strap, ¼ inch wide, soldered to pin 5"; transmitter circuits feature $17 tubes; and "a real low noise rf amplifier tube" costs $10 and up.

With this and lot's more like it in mind what would you say to a $1 tube used in a good, variable capacity-tuned local oscillator for 1215 mc? There is no mystery about it (except maybe a little in the cathode circuit) but it may sound as though there was before you really study the subject.

A great many electronic problems, defective operation, unsatisfactory results, etc., are found to be the result of not one but several troubles working together. We have mentioned this in a previous article (73, Feb. 63). In as many as six different items, the absence of any one of them can cause inability to reach the desired goal.

On 1200 mc it's the same way. It takes a number of things together to operate inexpensively.

Details

1. The tube: So far as I know there are only a few low cost tubes that will perform on 1200-1300 mc. A. The 6AF4, B. the 6T4, and C. 6DZ7. As usual, the radio and TV industry has given the amateur a lift. When it is built for those boys you can be sure it doesn't cost much! I'm not kicking. On the contrary, I look for the "82 channel law" to benefit us amateurs like mad. Like maybe with a $2 low-noise lighthouse tube. And UHF tuning capacitors for 25 cents, maybe.

2. The tuning capacitor: Good old Hammarlund Co. has made these for some time. I do not know of any other capacitor except the Hammarlund type macbf butterfly type that

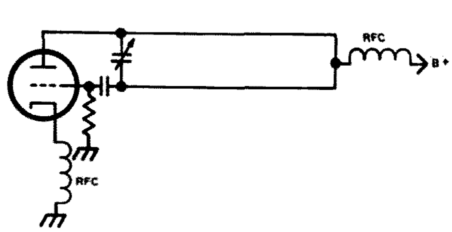


Fig. 1. Quarter wave oscillator.

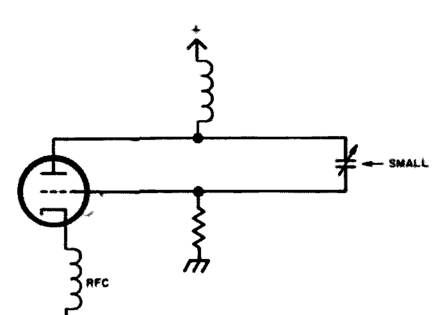


Fig. 2. Half wave oscillator.

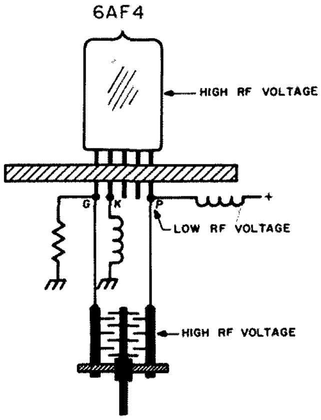
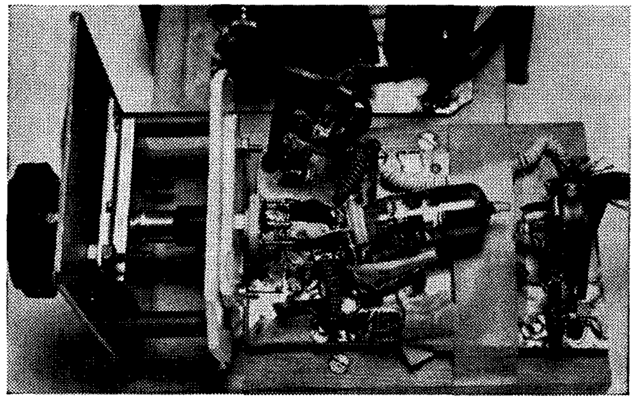


Fig. 3. Practical half wave oscillator.



Receiver local oscillator/Transmitter

will do the job. I mean of course, drill a single hole, use a 10 cent shaft extender, an 89 cent slow motion dial, and tune from 1100 to 1300 mc.

3. Half-wave lines: Let's try it this way. Half wave lines are well known but wait and see what happens when you add all together. Fig. 1 shows a simplified circuit of a 200-300 mc quarter wave line oscillator. Note that the "line" is acting like the old familiar pre-war ulta-audion circuit, with the plate on one end and the grid (out of phase, which is of course correct) on the other. This works fine up to a point. This is where the line shorting bar has arrived in the vicinity of the socket and grid capacitor. If you squeeze everything like mad it will go well over 500 mc, but don't use this circuit there! Fig. 2 shows a much better way. Note that now there is a half wave line on *each* line, so that if you consider the phase out and back you could call it a "full-wave oscillator". The trick now is that you can jam the first quarter wave right into the tube and, as in Fig. 3, you can still tune it with an "ordinary" (one that you can buy ready-made) capacitor! Even to 1400 mc! With the smallest Hammarlund butterfly type, 2 stator and 3 rotor plates, it tunes from well below 1100 mc to over 1300.

4. Don't go away yet. There are still some other ingredients. The shape of the lines next. As you go up in frequency towards microwaves (1400 mc) you will find more and more that the configuration of what you are using becomes of greater and greater imporance. This leads eventually to waveguides but these are not in today's lesson. However, the use of flat opposed straps of thin brass (should be silver-plated) for the "lines" in Fig. 3, which is the same as Fig. 2 but going p in frequency, is a must.

5. Socket: Believe it or not, there is a socket used! It just happens that for UHF TV there is a very thin porcelain socket, which grabs the tube pins right up close to the glass base of the tube and allows you to make connections which are very short. Don't try the usual VHF kind. Believe me, you need everything working for you at 1400 megacycles. You don't have to go to 1400, but if 1300 is the end of the line you won't do very well on 1296.

6. The "ground-plane" chassis: It has been found by trial and error that on positioning both the lines an equal distance, about ¼ inch, from the base plate on which the oscillator is built, the maintenance of correct phase will be a:ded. Just one thing in mind, if you make a Chinese copy it will work up to 1400. Most of those I have built are still oscillating at 1500 mc, but that's it. The end of the line. Remember, this is still a $1 tube plugged into a socket.

7. The cathode circuit: Here there might be a little "magic". A "good" circuit (that is, expensive) on L. band (1200) with a plunger tuned coax cavity between the plate and grid

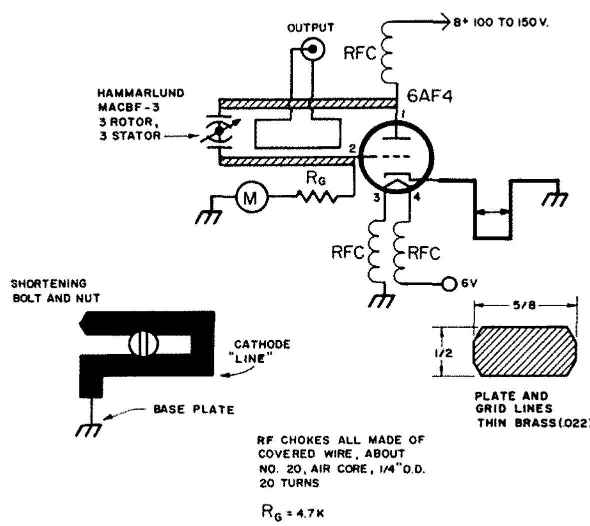


Fig. 4. L.O. and transmitter.

TOP VIEW

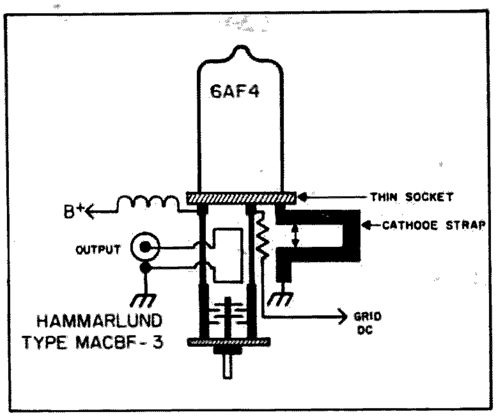


Fig. 5. Top view of oscillator.

of a 2C40, and another between the cathode and grid, will have a relatively easily determinable phase relation between the cathode and the plate. This is known as "in phase", or, as the cathode goes positive, so does the plate. The grid goes negative, "releasing" the plate which goes positive, etc. However, in an inexpensive "TV" triode such as the 6AF4 the plate, grid, and cathode are all in there together. The grid does not separate the plate from the cathode as in the 2C40. The plate-grid capacity of the 6AF4 is 1.9 mmf, which makes the fixed capacity on the tube end of the lines in Fig. 3. Now, what about the cathode? The "bible" says C gk is 2.2 mmf, and C kp is 1.4, but this doesn't help much. So, back to the good old "trial and error" again. After all Faraday didn't do too bad using this method a good portion of the time. After some years of it I have evolved a method of treating the cathode portion of triode oscillators that at least works, even if it isn't exactly obvious just how. A certain small amount of inductance down to the base plate from the cathode does the trick. It tunes quite broadly which is just as well, but it does peak up and it is repeatable. (This means that you can build a lot of them and they will all show the same kind of cathode tuning. I have built several "three-rod oscillators" in which the cathode was definitely tuned with respect to the grid, but that is another story.)

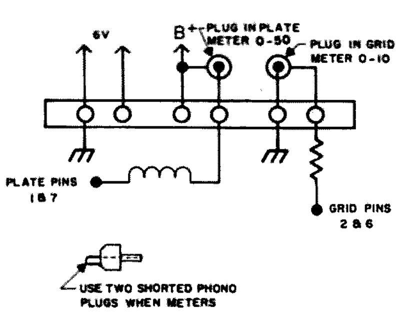


Fig. 6. Metering and power connections.

Construction Details

Now, with the seven items listed above in mind, we will build the oscillator of Fig. 4. Once again thin copper-clad bakelite makes an excellent baseboard. Mount the Hammarlund type macbf capacitor on the vertical insulating front panel as in Fig. 4B. The grid and plate lines, the UHF socket and the tube make a unit which may be held together and supported by soldering to the tuning capacitor. The socket may also be supported by a piece of insulator if you wish to make the assembly stronger. The B+ rf choke must be soldered directly to the plate pin (pin 1) of the socket, and the grid resistor directly to grid pin 2. That is, with the tube mounted as shown, which it must be, use the uppermost pins. Note that the plate pins are 1 and 7, and the grid pins are 2 and 6. Details in Fig. 4. This means that the solder which holds the socket pin to the brass plate line also holds the end of the plate choke. There isn't too much room there but it does work. Ditto for the grid resistor and grid line.

Firing Up

I generally use a couple of phono jacks for meters on the cable strip. See details Fig. 6. This frees your meters for other rigs. With 6 volts ac on, the tube should light up visibly. If everything is ok the plate current should rise as the plate voltage is turned up. It's a good idea to have a variable plate voltage supply for these tests. At somewhere around 15 to 20 ma the tube should start to oscillate and the grid current should begin to rise also. Plate current of some 25 ma may be found

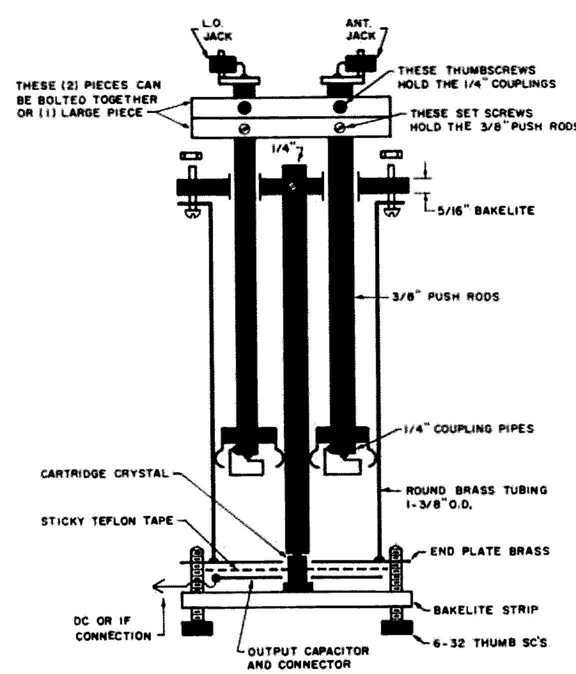


Fig. 7. Cavity mixer for 1215 mc.

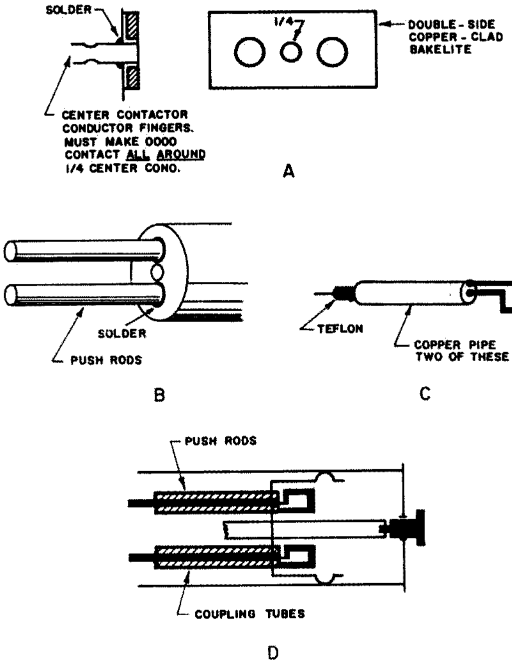
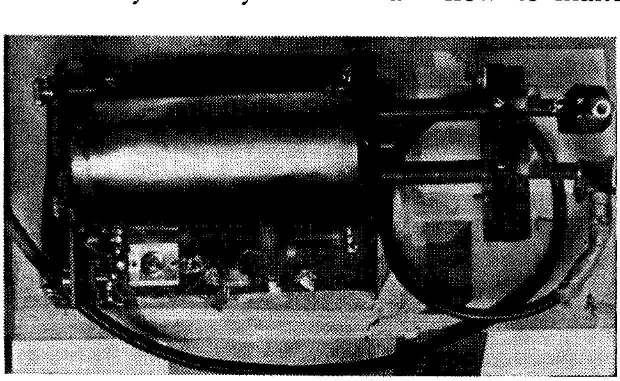


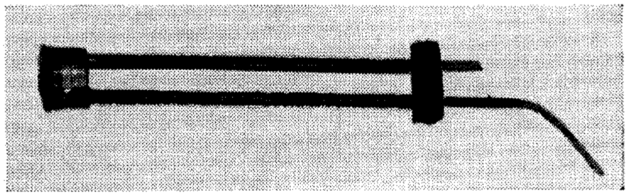
Fig. 8. Details of the cavity.

at 1100 mc rising to over 30, or even 35, near 1300 mc. The frequency of this unit can be adjusted for 1200 to 1300 mc, less the *if* frequency used. This little word "adjustment" actually means unsoldering and cutting the brass strips or making new ones. That's just part of the fun. For an *if* amplifier I have been using a slightly modified ASB-7, double frequency *if*, first stages on 52 mc. A low cost do-it-yourself *if* will be described later, but there really are (or were) loads of surplus wide band *if* strips around! Don't forget that 1215 is the modulated oscillator portion of the band, by general agreement, and this means an *if* bandwidth of several megacycles, not kilocycles. Use whatever dial you wish for the tuning control. Don't forget that the butterfly capacitors tune only 90 degrees.

Good Cavity Mixers for 1215 mc

By good I mean ones that really tune, putting 1215 into the crystal, the desired *if* out, and nothing else! This is a long story, so settle down. If you do you will learn how to make


Typical cavity.

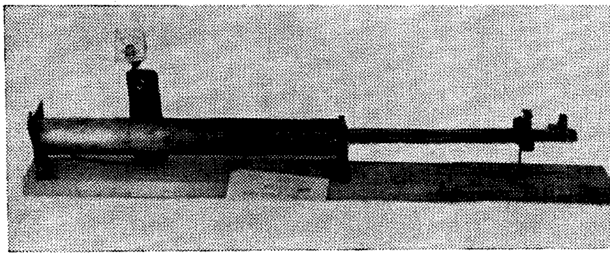

Push rod for inside of cavity.

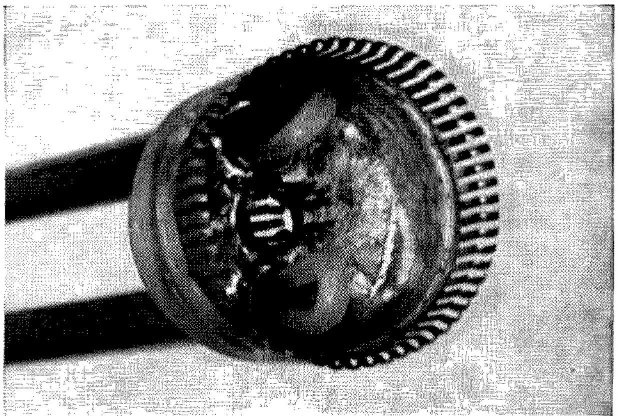
a good tuneable cavity for 90 cents. I have made several of them and have been using them ever since. They are also easy to take apart and service or modify. You can pu tubes, transistors, or diodes in the business end of them.

These cavities also have considerabl "growth potential" as they say on Madiso Avenue. If you make the *if* output coils plug-in, you can also use the cavity as a basic element for a narrow-band converter later. Plug in a 14 mc (or other, to suit your communications receiver) *if* coil, (see again Fig. 9.) remove the tuneable local oscillator cable, Fig. 7, and plug in a fixed tuned local oscillato chain. That is, later on, when you either make one or get one. This tends to sort itself out automatically. The customers generally fall into two groups. They have quite a lot of time and not too much cash, (usually a youthful group), or they will have more dollars and not near so much time available. And what time they do have they want t spend operating. This more or less describes the "family man." The main body of this article is obviously slanted towards the firs group. On the air I have noticed that the amateurs interested in 1200 mc are almost always quite young. Of course there are always a hard core of born experimenters who carry on with this sort of thing till they die, but they are not so numerous.

Cavity

While, as I said, some kinds of coil or line circuits can be made to work on 432 mc, and oscillators to 1200, to achieve good repeatable tuning on 1300 takes a little work and understanding. I have tried a large variety of circuits and methods and some of them work after a fashion. That is, a poor fashion. Lines get to be ¾ of an inch and do not like to be


Another cavity.

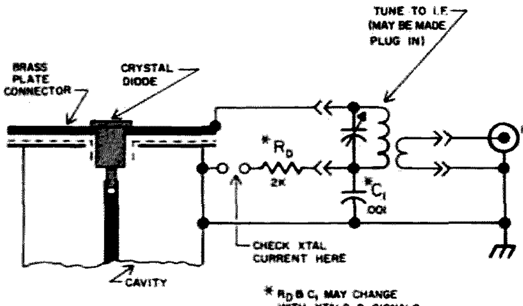


End of push rod.

enclosed. Condenser tuned coax cavities are also about ¾ of an inch long. I have made some of them work but they are still nothing like the plunger tuned coax tuner I will describe here. The difference is immediately noticeable. Fig. 7 shows a pictorial diagram. Now don't be scared by it. While this looks similar to previous pictures you have seen, there is no lathe or machine shop work in this one. You understand, I have nothing against lathes personally, it's just that I have never learned to run one, and having obtained my first license in 1923 (2BAV) I'm not likely to learn now.

The following items should be procured at the plumber's shop: thin wall brass tubing of 1½" and 1⅜" O.D. copper tubing, ⅜" and ¼" O.D.; clean .022 brass plate. Now, cut a half inch length of the 1⅜" O.D. tubing, and solder on the finger stock. A small piece of steel wire, or enamel wire will help hold the finger stock in place while soldering. Or use a small finger-vise or clamp. Now solder the finger ring to a piece of copper clad bakelite, which has first had three holes drilled in it, Fig. 8A. The result should be as in Fig. 8B.

Now strip the outer conductor from two lengths of Teflon insulated RG58/U and slide them into the quarter-inch copper pipe, making small loops sticking out of one end of each pipe, as in Fig. 8C. These "coupling pipes" are then inserted inside the push-rods, see Fig. 8D, and positioned temporarily by the 6/32 knurled thumbscrews shown in Fig. 7. The loops, Fig. 8E, should turn freely at least 90 degrees inside the cupped (inside) end of the shorting plunger, one on each side of the center conductor (see Fig. 8E) allowing the coupling of the antenna and local oscillator to be varied independently as needed. Some lengthwise variation in the positioning of these loops may be tried, but better keep them well inside the finger ring, as per Fig. 8E.



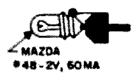


Fig. 9. *if* output.

Fig. 9B. Dummy load.

The other ends of the cables may be brought to jacks as in Fig. 7, or may be left longer and fastened directly elsewhere as needed. The brass end plates, Fig. 7, should be soldered to the outer wall. Sticky Teflon tape, perhaps two sheets of .002, is applied to the end plate from the "output capacitor and connector". See again Fig. 7. This little brass plate (see also Fig. 9.) is quite important. It bypasses the rf (1200 mc) but leaves the DC, in the case of use of the cavity as a wavemeter, or the *if* in the case of a mixer. Fig. 9 shows a simple *if* circuit that has never failed me yet. You can make the brass plate larger for more bypass action, or smaller for use with a higher *if* frequency, such as for a TV channel when using this cavity as an ATV converter. Notice that the brass plate and the outer shell, or "ground" form a fixed capacitor across the *if* output transformer primary, and so will be in parallel across the *if* tuning capacitor. If a slug-tuned *if* is used then it may constitute the fixed tuning of such a circuit.

So far, this type of cavity, with the crystal diode directly across the "hot" end, puts out more DC as a wavemeter, and more *if* as a mixer, than anything else I have encountered yet on 432 and 1296. It is also an excellent filter for the frequency to which it is tuned, as it is very positive in tuning. For example, 1296 stays at one spot on the dial with different antennas and different local oscillators. This is due to an extremely important principle in VHF and UHF work. A large cavity, such as this one, has a terrific "short circuit capability" for any frequency except that to which it is tuned. This shows up like mad in front-end work, where a small-wire coil will pass all kinds of images, harmonics and other junk. The large properly made cavity will not! You can also put your hands all over the outside with a signal on the inside and no change in tuning or output will be found.

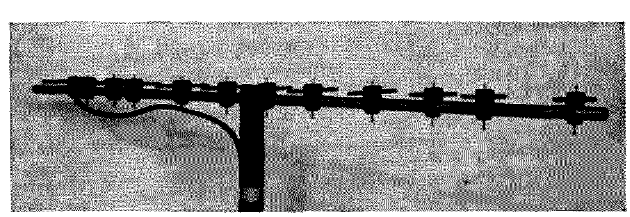
This about finishes the "1215 Receiver" article except for station operation. As described it tunes nicely with test transmitters and the heavy radar signals which are heard almost anywhere in New England.

Low Power 1215 mc Transmitter

So far I have used the same type of oscillator for transmitting as the one described for use as the local oscillator. About the only difference is that for the local oscillator use about 30 to 35 ma plate current, whereas the xmtr can run 40 ma. (If you have half a dozen 6AF4's on hand, live it up! I still wouldn't go over 50 ma. Anyway, you're on your own there.)

The B+ for the transmitter also goes through a small 5 watt modulation transformer. A single 6AQ5 more than modulates the 6AF4 with a carbon mike and high gain mike transformer (30 ohm to 500K). Be sure to use a gain control on the grid.

It is also handy to make the output coupling loop (Fig. 4) variable, because when the beam is tuned up properly, it can easily overload the oscillator and block it off. When in that condition, putting your hand on the radiator or reflector will detune the beam plenty and bring the oscillator back into action again. This of course shows that the beam is tuned up. Or at least part of it! I mounted a piece of quarter inch bakelite rod through a thick piece of upright bakelite with a locking thumbscrew. With a one foot piece of RG58/U cable soldered to the output loop, which is quite small, about ⅞" long by about 3/16" wide, a no. 48 Mazda bulb lights easily on 35 ma plate current and shows about 200 to 300 milliwatts of 1215 mc rf when using 45 ma on the 6AF4. I mount these 60 ma 2 volt bulbs on a phono plug with coax leads. See Fig. 9B. They are handy rf power output indicators. Don't leave them in circuit though, or you won't have any power left for the antenna. Best for the moment to set the output coupling loop for maximum reading on the distant (10 to 15 feet) detector and beam, and note the grid and plate current.



1215 mc yagi

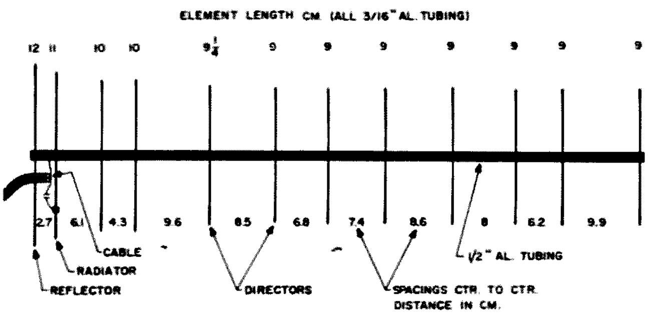
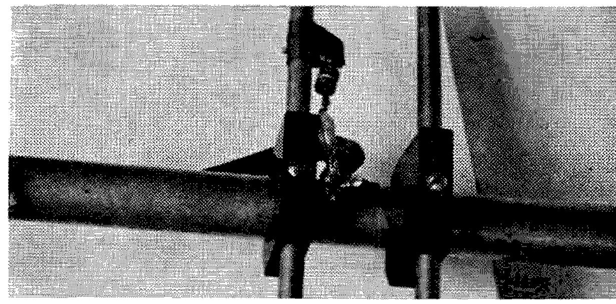


Fig. 10. 1215 mc yagi dimensions.



Gamma match.

1215 mc Beams

Two of these will start you off on 1215. With the transmitter on one beam and the mixer cavity used as a power detector on the other beam, by connecting a 0 to 100 microampere meter in the place of the *if* coil (or in series with it) the meter shows full scale with the beams pointing at each other 10 to 15 feet across the room.

Figs. 10 through 14 show details. Again, make Chinese copies and they will work. They are very handy for getting started. Then you can go creative and try anything you wish using these little ones as standards, test antennas, etc.

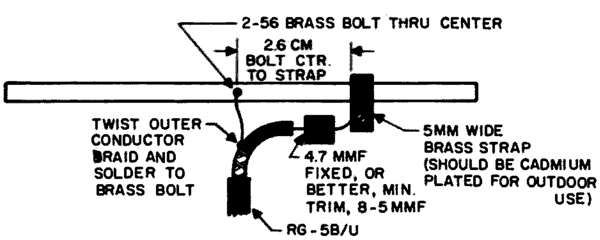


Fig. 11. Driven element of yagi.

There is only one adjustment you should make on these beams. Plug in the transmitter (I used about 10 feet of RG58/U to start (probably makes about a 3 db pad, at least)) and, watching the distant (ten feet) receiver (use a DC cable to bring the meter back near you so you can read it) meter tune the gamma match capacitor with a screwdriver made of fiber, with no metal tip. You can also try a few different spacings, for the reflector only, adjusting the gamma capacitor each time, or leaving a sub miniature fixed 4.7 mmf capacitor there. See Fig. 2. Do not change any of the director spacings. Once again, these little firecrackers are just to start with. All kinds of things can be done later. Skeleton parabolas, four corner reflectors vertically stacked, sky's the limit. At least you now have a low cost, test oscillator-signal generator, two good beams, a low cost receiver, a small antenna range, and you can work across town!

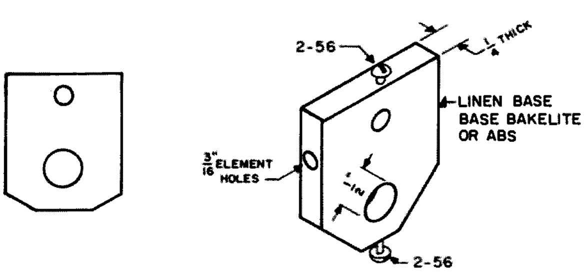


Fig. 12 and 13. Details of yokes.

K1QNM took one unit to his shack about half a mile away in Melrose, Mass., through trees, houses, etc., and came in very loud using his beam indoors. My beam was just outside the roof about one foot average above a skylight on the third floor.

Of course, a good deal is to have some local lad near you make up a second complete rig along with yours. How far will these go on mountain tops? You think I should already know? Listen, good friend and reader, fellow 1215'ers are scarce enough! In the cold weather I do circuit work!

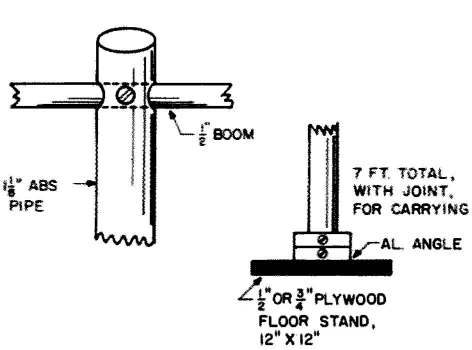


Fig. 14. Antenna mast and support.

I use one beam on the receiver and another on the transmitter, without rf switching, so far. I intend to run a series of 1215 mc tests on cables, connectors, switches, and relays, soon, however, and hope to let you know the results, via 73 grapevine.

. . . K1CLL

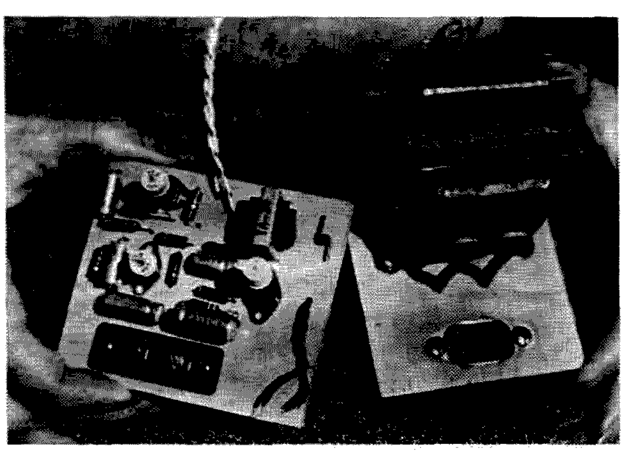
Ken Cole W7IDF
P.O. Box 3
Vashon, Washington

Total Boredom

How many times have I read a "handy hint" in a magazine and thought: "Of course! Why didn't I think of that?" And later, when the ingenious suggestion turned out to be less practical than imaginative: "Naturally! Why didn't I think of that?"

Most often I do this mental two-step to my own tunes. The mechanical facts of life kill off a majority of my inspirations with swift mercy, often leaving a legacy of odds and ends best referred to frankly as trash. Like all these nice aluminum cans that came filled with Red Kettle soup mix—a good product but one I didn't need. In the supermarket these "handy parts containers" stacked perfectly. But not after they had been opened.

On the other hand, some ideas work just fine, but who needs them? And how often? Clip the point from an exhausted ball-point filler and force the empty plastic tube through a hole in a cork. Slip a few inches of spaghetti (our kind) over the other end of the tube.



Chassis. See text.

Put the free end of the spaghetti into a plastic pill bottle filled with water. The bottle cap should have two holes drilled in it—one a tight fit for the spaghetti. Now you have what is known as a "handy air seal." And all you need to make it work is a gallon of fermenting wine in a jug that fits the cork.

Some hints are real time-savers but others, offered with the best of intentions as safety measures, develop corollary dangers which can be at least as lethal as the original hazards. In a recently published article the suggestion was made that a 2.5 mh rf choke in the range of 200 to 300 ma be connected from a tramsmitter output to ground. In the event the plate blocking condenser shorts, the choke is expected to function as a protective device, grounding the plate potential and blowing a fuse in the power supply. In many transmitters it would be more typical for the rf choke to burn out before the fuse would go. In this event, unless the operator is both alert and wary, someone is likely to end up with a handful of volts. The shock would be psychological as well as physiological for his attitude will have been conditioned by confidence in the fact that he has installed an extra "safety measure". Indeed, this self-assurance may be the immediate cause of his making that last wrong move.

Ready for the "handy hint"? Use model airplane balsa sheets for transistor circuit boards. It's cheap, light, easy to work, ubiquitous, and it floats. With a soft lead pencil you can sign your creations, label, comment and start holes for parts and hardware. You can work resistor and capacitor leads through thicknesses up to a quarter inch with no diffi-

culty, although it's something like giving a penicillin shot the first time.

I prefer quarter inch because it's strong enough to permit bolting small transformers, chokes and terminal strips. The transformer in the photo is a ten volt doorbell unit used here in a nine volt transistor-experimenting power supply. The completed board was aligned with an identical piece which had been coated with airplane cement, and then it was carefully stepped on. This forced the wiring and other odds and ends into the surface of the lower board, permanently hid the amateur workmanship (no pun) and saved the cost of rubber feet. There are very few surfaces a sheet of balsa will mar.

Splinters and grain are no problem with this wood, and your wife will agree the color of balsa blends nicely with the modern decor she reads about. The light hue provides an effective background for the components in the event photographs are requested by your attorney, 73 or Western Electric, and you will find it gives a certain lift to your circuits. Speaking of lift—when you give up on one of those maddening projects that just will not work, you can hit back by pinning wings to the circuit board and giving it a savage overhand launch into the blue. The natives will wonder for weeks what to make of a glider with an aborted multivibrator piggyback. Lately, to spare a lame right arm, I've been taking my rejects into the tub with me, where they make very avant-garde rafts for my plastic ducks.

Bill Smith KØCER

Oscar III:
Some observations

"It is up" . . . three words that opened the door to another era of Amateur Radio communications. These are the words that flashed around the world March 9th when OSCAR III completed its first orbit at 1930 GMT.

OSCAR III was launched from Vandenberg Air Force Base and a short time later was reported in a Polar orbit about 500 miles high and circling the Earth once every 103 minutes at a 70 degree inclination.

From my own observations, and those that have been reported to me, the satellite functioned as planned with the exception of the 145.950 megacycle beacon, I did not hear it and I know of no one who did.

However, the well-known, friendly "HI" signal and telemetry beacon on 145.850, plus or minus depending on Doppler shift, was loud and clear.

The transmitting pass-band from 145.875 to 145.925 also functioned well although a few kilocycles lower than planned.

I began tracking on the sixth orbit but did not hear any amateur signals until orbit number 8, although the "HI" beacon was very strong, about 25 db over receiver noise.

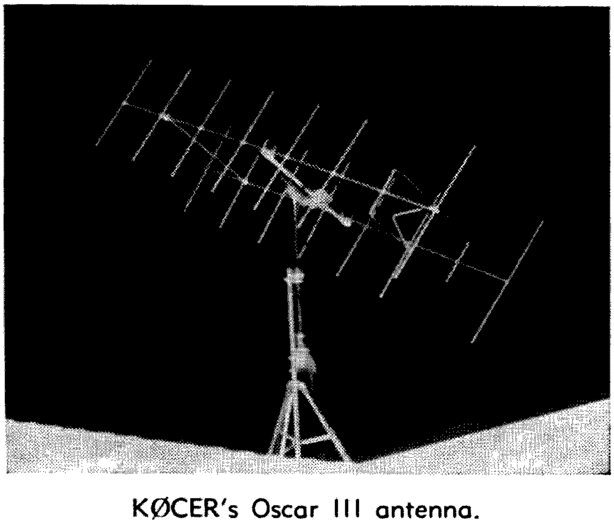
The first amateur signal I could identify because of the QRM and QSB was that of K9AAJ . . . the same gentleman, who along with K2IEJ, made the first confirmed two-way QSO via OSCAR on orbit number 13.

Another contact that may be of interest, although the two stations are only some 360 miles apart, was on orbit number 76. K9AAJ worked KØCER when the satellite was off the southeastern tip of Greenland. THAT is a long way around to work a station 360 miles away!

The maximum distance that I was able to hear the "HI" signal was somewhat over 3,000 miles with 2,500 miles being consistent.

Being located in the midwest puts me in a rather favorable position to hear stations throughout most of the United States. Over 20 states were logged with K9AAJ, K4IXC, K5TQP, K2IEJ, K3KEO, K9UIF, WA6MGZ, and K5WXZ having the most consistent signals.

Now for some observations. These should prove of interest for comparison and I welcome any comments for a later article where some comparisons can be drawn.



KØCER's Oscar III antenna.

1. There appeared to be no difference in signals between north and southbound passes.
2. The "HI" beacon could be acquired usually about 8 minutes before TCA but the largest number of amateur signals were heard immediately after TCA until the abrupt cut-off as the satellite passed out of range, about 2,500 miles.
3. There was a very marked signal increase just before the satellite dropped over the horizon.
4. Horizontal and vertical polarization worked about equally well except during passes that were nearly, or directly, overhead. Vertical polarization and being able to point the antenna at the satellite showed a marked improvement over horizontal polarization.
5. QSB . . . we all cussed this. The QSB was probably THE limiting factor in preventing more QSO's. A signal would be solid copy for about 10 to 30 seconds and then disappear. This was no doubt due to the pitching of the satellite in space and made meteor scatter techniques for information exchange a must. The QSB and the Doppler shift caused many QSO's to be lost. I probably lost seven due to this and I heard any number of fellows miss out the same way.
6. Slow speed CW (I heard only one AM and four SSB stations) would have been the best way to cope with the rapid signal strength variation, but the short duration of the signals forced keying speeds in general of 20 wpm or more. This hampered the "phone-only" operators.
7. The "HI" beacon could be copied on the simplest of receivers but it took a good, low-noise converter/receiver to pick out the ham signals. The ham signals appeared to be only about one-half as strong as the "HI" beacon. The beacon could be copied continually but not ham signals.
8. Buck-fever. I guess we all suffered from this. During the first 75 or so passes everyone was calling CQ. Later the trend seemed to reverse and everyone was listening. Somewhere along the line we are going to have to adjust ourselves to this kind of communication.
9. I know of no station using the OSCAR Association suggested transmitter power of 100 watts. I used 400 watts. This might have had something to do with all the over-all amateur signal strength being less than the "HI" beacon if the translator power was being "used-up" by the high-power boys. Maybe it takes higher power to work through the satellite than was anticipated.

In summary, it would appear the amateur who was an experienced operator and fairly well equipped had the most success. We all learned the fine techniques of satellite tracking, developed our own ideas of what was the best antenna and which polarization to use, and operating procedure. This experience will be most helpful in future OSCAR's and we should see more contacts being logged.

I am most interested in receiving reports from all participating operators and will put the information together for a future article where we can all gain from each others experiences and observations.

And finally, a salute and a thank-you for all the efforts of the Project OSCAR gang, a job well-done, fellows.

. . . KØCER

Letter from Gus

Calcutta, India
March 8, 1965

At this moment I am setting in a small hotel room here in good old Calcutta, India. I keep thinking about Peggy leaving me all to my lonesome on the 11th when she will leave here for home, ICE COLD COKES, hamburgers, Southern Fried Chicken and rice, and seeing those FB Grandchildren! Boy I kind of wish I were going home along with her, but I have promised her I will be home by Christmas—and I HAPPEN to mean it THIS TIME.

You boys want to see a real Ham license—well here is an exact copy of my Bhutan License:—

RADIO AMATEUR STATION LICENSE

Gus M. Browning of Route 1, Box 161-A, Cordova, S. C., United States of America are hereby issued a license to operate an Amateur Radio Station in Bhutan.

He is permitted to use a call sign of his own choosing provided it begins with the letters AC.

It is understood that he will obey the rules and regulations that pertains to the operation of radio Amateur stations, thru out the World.

This license is good for the life of Mr. Browning, no renewal at any time is necessary, of course it may be cancelled by the Government of Bhutan at any time.

THIRD party traffic may be handled with any radio amateur station. Telephone patch may be used at anytime. Dated this 21st. Day of Jan. 1965.

Signed by the
Chief Signal Officer
for the Government of BHUTAN

Now boys ain't this a dandy Ham license? THAT is the kind of license I LIKE!!!

Peggy and I just arrived here from Bhutan, I plan to go back there on the 13th of March. So far I have operated from AC5 and AC8 (12500 Ft up) and when I go back I plan on going to AC9 after another shot at AC8 and if possible even ACØ, when the snows melt and if things are RIGHT and nice and QUIET maybe even even AC4—but you won't hear that prefix ever given—it will just be AC8/ (with NOTHING after the / mark. Of course AC3 is very strong in the plans and this may be the hardest one of the lot to pull off this time. I will be trying and I mean trying VER YHARD, but this one will not be easy. BE ON YOUR TOES BOYS this one may come out of a clear sky without any warning at all. I hope it will be right after the 15th of April.

Conditions have really been stinko. They are the worst I have ever seen. The openings are short and usually weak. My GOOD EQUIPMENT at this moment is still in the INDIAN CUSTOMS here in Calcutta. I have been stuck on Transceive up to now with only 100 watts input. The new rig has 2 VFO's and 300 watts input and getting it thru INDIAN CUSTOMS will be really tricky this time. They want me to get a license from their Ministry of Transport and Communications JUST TO BE ABLE TO TAKE IT THRU THEIR INNER LINE (the Inner line being a strip of land just south of Bhutan, Sikkim and Nepal) I intend to stay here in INDIA until I have exhausted EVERY MEANS of getting this equipment to Bhutan with me. THESE INDIAN CUSTOMS are MEAN—they go by THE BOOK and the book has a lots of very fine print in them—and they are reading EVERY WORD of the fine print this time. I sure hope I get a chance to use this fine lab built gear that Hammarlund built up especially for me. Stick with me boys—I AM A TRYIN' and A SWEATIN' THIS ONE OUT.

CAN SOMEONE TELL ME PLEASE WHAT HAS HAPPENED TO THIS RECIPROCAL LICENSING STUFF? It ain't helped me a bit yet. How about you fellows writing your Senators and Congressmen and ASK THEM WHAT'S BEING DONE on that bill! The bands go out in AC5 at 1300 Z and at AC8 about 1400 Z. EXCEPT for Raju-VU2NRA who is still the loudest thing on the bands ALL THE TIME even when the

con't. on next page

VHF

LATE OSCAR FLASH

It would appear the Repeater is beginning to fail on about orbit 210. On orbits 213 and 214 the "Hi" Beacon was peaking 50 DB over noise but no evidence of any repeated signals although "pings" similar to meteor scatter signals were heard faintly. WØENC at Rapid City, South Dakota reports the battery voltage down to about 18 volts. The last amateur signal heard here was from K2GUG on orbit 201 peaking 25 DB over noise. WØENC reported hearing K9AAJ, WB6KAP and K2GUG on orbit 202 but nothing identifiable after that.

With this issue of 73 comes the initiation of a VHF column. Wayne and I hope you will enjoy and support it because only through YOUR support and interest will it thrive.

A short time ago Wayne asked for your comments on whether 73 should carry some columns on selected topics. Forty per cent of you said you wanted a VHF column in 73 so after the exchange of a number of letters between Wayne and myself he gave me the go-ahead.

It is our intention to aim this column at the technical and construction aspects of the field and it is along these lines we shall move. In doing this, I solicit and welcome ideas, your pet circuit, technical and construction projects, suggestions and criticisms. I realize that a great number of VHF/UHF operators just simply do not want to take time away from their projects to write a finished article. This is where I will come into the picture as your editor. I will take your notes and rough drawings, etc. and put them into finished form so each of us can benefit from the work of each other.

Now a short introduction is in order. I was first licensed in 1955 and after two years on the DC bands, moved to six meters operating from Iowa, Arizona (as K7RIA) and South Dakota. In August of last year I switched to two meters and that is where I operate most every night with 400 watts of CW. I am 25 years old, married, have a daughter and am employed as the news editor of a Sioux Falls radio and television station.

Enough of that, and on with the column.

During the past several weeks the eyes of the VHF world have been focused on a small package of transistors circling the globe once every 103 minutes.

OSCAR III is writing new pages into the history of amateur radio in the space age. What are some of these pages of history? Let's look at some "firsts."

K6GSJ heard the first repeated amateur signal from OSCAR, that of K6UQH on the very first orbit. On orbit six, W8PT heard W4WNH for the first "long-distance" repeated signal. The first confirmed two-way contact came on orbit 13 when K9AAJ and K2IEJ contacted with signals of a meteor scatter nature. The first reported two-way QSO outside of the U-S came on orbit 20 between HB9RG and DL6EZ. Leave it to W1BU to come up with another first. On orbit 19 he heard HB9RT for the first Trans-Atlantic reception of a repeated amateur signal. On orbit 51 KH6UK scored a Trans-Pacific first when he heard WA6MGZ. K9AAJ reported hearing KL7CUH on the ninth orbit. W6NLZ and K2GUG scored the first coast-to-coast QSO on orbit 35 but W1BU seems to have outdone them all. On orbit 61 Sam and DL3YBA spanned the Atlantic for a two-way contact. I also have a non-confirmed report that Sam worked HB9RT also. The above information is accurate with the possible exception of when W1BU heard HB9RT, the orbit number might be wrong because of a garble in KØSZJ's teletype copy. I am sure there have been other similar firsts but I have not received reports of them. How about it, you fellows that were involved? I might also comment that the first two-way contact, between K9AAJ and K2IEJ, was copied here from both stations.

Next month, most of the country should be defrosted enough to think about antennas, so we will cover matching harnesses and beam stacking. While you'r thinking about that summer antenna project, look at these figures before you buy your new coax feedline.

VHF

DB loss @	30mc	50mc	144mc	432mc	Price/ft.
RG 8 U	1.0	1.4	2.8	5.2	10c
RG 11 U	.9	1.3	2.5	4.7	9c
RG 17 U	.4	.5	1.1	2.3	66c
RG 58 U	2.0	2.7	5.5	10.5	3c

It is false economy to buy inexpensive coax for VHF applications. Even at 2 meters RG 58 U soaks up nearly 75% of the transmitted power before it reaches the antenna.

Also planned in the near future are articles from WØCTM on 432 megacycle transmitters, tropo dx by WØEMS and so forth.

Please do let me hear from YOU.

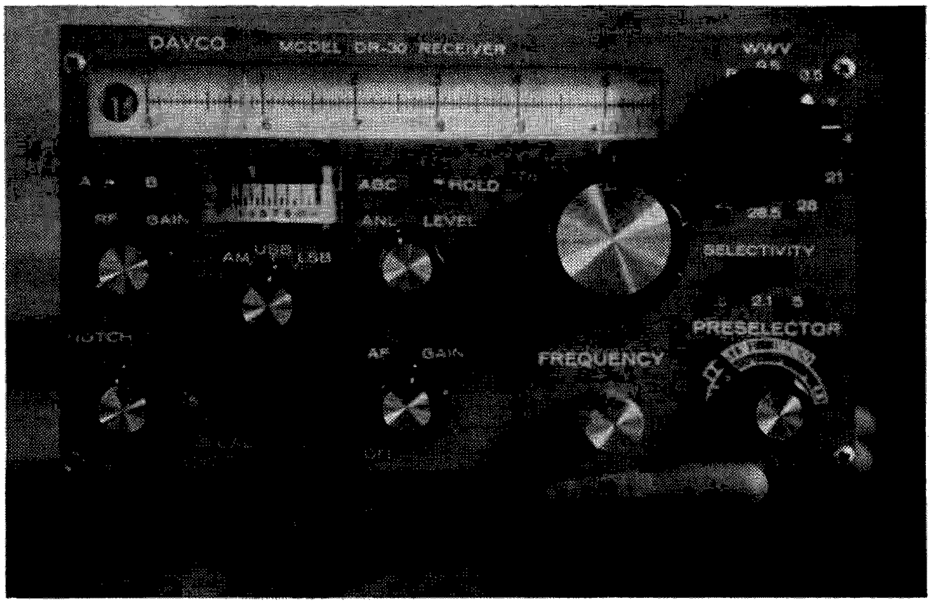
Bill Smith KØCER
1301 Churchill Ave.
Sioux Falls,
South Dakota 57103

Gus

bands are DEAD for anyone else. They must have the exact perfect skip for AC lands and VU2NRA lands ALL THE TIME. 40 meters—Ha Ha Ha, boy that's a joke with all those commercials there—and I mean ALL OVER THE BAND too, right down to 7,000 kc, once in a while you might find a 1 kc hole near 7,000 kc. I keep trying on 40 but it really looks like it's a losing battle. I keep trying about 0000 Z until 0130 Z and again 1000 to 1200 Z and also at other odd times hoping it may open up accidently. Don't give up fellows. W8FGX and W8JIN SHOULD COME THRU SOMETIME!!! I did hear a W1 once and one single W6 and that's all as far as the USA is concerned.

COME ON SUN SPOTS I AM AWAITIN' FER YOU—

. . . Gus



Paul Franson WA1CCH

Testing the Davco DR-30

I was skeptical when I read the first Davco ads. You've seen them. The Davco DR-30 is a ham band transistorized communications receiver. That's not much of a surprise. We've all been waiting for one for 10 years. But the DR-30 sounded like a 75A4 crammed into a file card box—and then some! How could they fit all that performance, versatility and reliability into 1/10 cubic foot?

When the Davco arrived, I found out. They threw away the book of old-fashioned conventions on this one. It's the first really up-to-date amateur equipment I've seen. Davco has used modern techniques that are long overdue in ham gear. The DR-30 isn't just an old receiver stuffed into a little box; it's completely new. The first thing you notice about the DR-30 after its small size (4 x 7 x 6) and good looks is how solid it is. It's a heavy handful of high quality parts and state-of-the-art techniques: The "chassis" is a solid extruded aluminum frame with 3/16 inch walls. You couldn't bend it without driving over it. The controls are mounted on cadmium plated steel attached to the extrusion. The circuits mount on eight miniature fiberglass modules mount on eight miniature fiber glass modules that plug into mil spec connectors on the frame. High-Q toroids are used for the rf amplifier and VFO. The *if* transformers are the size of pencil erasers. A Collins mechanical filter, Clevite transfilters and a crystal filter furnish selectivity. In all, 15 diodes, 14 crystals and 25 transistors are used. All parts are high quality and conservatively rated.

Here is a complete high performance communications receiver that is compact enough to use anywhere: mobile, home, portable. It draws less current than a flashlight bulb, so it's economical to use with small batteries as well as in the car or from the power line. Yet the DR-30 offers exceptional performance. It uses dual conversion with a crystal-controlled front end. It covers every kc of the amateur bands between 3.5 and 50.55 mc (as well as 9.5 to 10.05 mc for WWV and two other 550 kc bands of your choice). The RF amplifier in the DR-30 uses high-Q toroidal coils for excellent image rejection and a UHF premium low noise transistor (2N2495). The noise figure of less than three db—even on six meters—and AM sensitivity of better than ½ μv means that you can hear those real weak stations when no one else can. It also means that the DR-30 is exceptionally quiet with no signal. None of that annoying hiss. In spite of all the advantages, transistors have one drawback compared to tubes: crossmodulation. Davco avoids this completely with a very clever trick: The RF gain control is an at-

tenuator in the antenna circuit. There is no loss when it's switched out, but the control provides excellent control action and seems to completely eliminate crossmodulation.

The DR-30 has three selectivity positions for optimum performance under all conditions in all modes. For AM, the *if* cans and trans-filters provide about five kc bandwidth. SSB uses a Collins mechanical filter for 2.1 kc. For the CW hounds, there is a very sharp (about 500 cycles) crystal filter used in addition to the mechanical filter. There is very little difference in audio level as you switch between the three positions if your signal is tuned in properly. The audio is properly restricted for communications, yet very clean.

The Davco doesn't seem to drift at all. I varied the input voltage from 11 to 15 volts, dropped the receiver on the desk, took it outside (brrr) and couldn't hear any change in the beat note with WWV. This is partly accomplished by the high stability toroidal oscillator coils, partly by the solid construction, partly by the zeners, and partly by very extensive development of the temperature compensating networks.

The tuning mechanism uses a flywheel with extensive spring loaded split gears for very smooth, slow, backlash-free action. The dial is calibrated to five kc, and the tuning knob to one. Tuning sideband is as easy as tuning WCKY.

The notch filter is very effective in taking out QRM and heterodynes. The 100 kc calibrator is included. One of the real bonuses of the DR-30 is the noise blanker. It's not just an audio noise limiter. It picks up the noise pulses before the selectivity of the receiver lengthens them and uses the pulses to turn off the receiver for the minute duration of the noise. It's very effective in getting rid of all types of pulse-type noise.

The case of the Davco is heavy steel with a hard, scuff and scratch proof textured finish. The panel is HP grey with white silk screened lettering. Knobs are professional black with chrome inserts. Very nice.

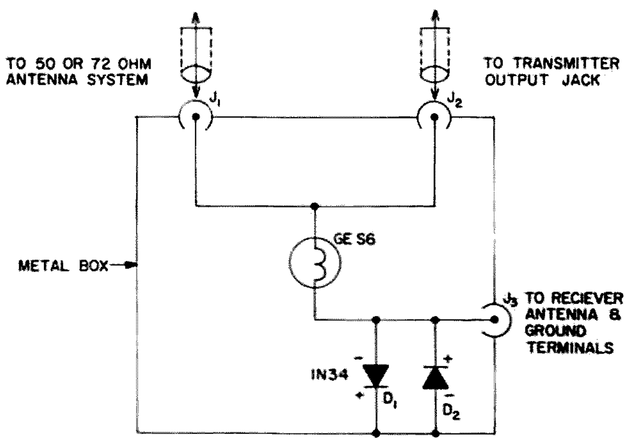
Davco has also announced the companion transmitter to the DR-30. It's called the DT-20 and has the same front panel size. The two plug together for complete transceive operation, yet each has a VFO, so the receiver and transmitter can be used on separate frequencies f desired. The DT-20 should be available his summer.

One thing that occurred to me before I used the DR-30 was that the small size might make operation difficult. It doesn't. In fact, I'm mpressed with the ease of operation of the receiver. All of the controls are there within easy reach. You don't have to reach all over a huge panel trying to grab the gain control or selectivity. All of the controls have the same solid feel that the receiver itself has. Using the DR-30 is a real pleasure. My first thought was that it would be useful primarily for portable and mobile operation. Well, it's invaluable for that, but it also is the best home station communications receiver I've ever used. It's more convenient, more versatile and works better than those huge old-fashioned heat generators. I compared it to other receivers and converters. It beat them all. On six, the tremendous sensitivity and low noise let me hear many stations I couldn't hear on the well-known converters. And the price! The introductory price of $337.50 is incredible. I don't see how they can make and sell the DR-30 for that. You can even get two for the price of some other good receivers. One for your car and one for your shack. I bet that the Davco will be more convenient, more versatile and work better than the big one, too.

You can see that I'm sold on the Davco DR-30. Try one out. You will be, too.

. . . WA1CCH

Economy TR Switch



Here is an electronic device that permits instantaneous "switching" of a single antenna from transmitter to receiver. It is simple to build and requires no external power supply. It will handle output up to 500 watts and will also operate on "flea" power such as a Heath Sixer when an outboard converter is used. The only disadvantage found in this unit is that it does attenuate receiver signal slightly.

The unit can be built in a small metal box where all parts can be easily mounted. It should be remembered to use a heat sink when soldering the 1N34.

This unit works very well on both CW and SSB and a single relay can be added and used on AM.

. . . W5ZBC

SEMICONDUCTORS

Paul Franson WA1CCH
73 Magazine

Welcome to the first of the monthly 73 semiconductor columns. I will write this column on the assumption that most types of vacuum tubes are obsolete, so will try to devote a good bit of the column to practical transistors for the average ham. At the same time, I'll try to tell you about the latest developments in semiconductors—even if some are a little beyond the reach of most of us. I'll be happy to hear about what you are doing and what you are interested in. Let me know about the transistors that you use. You may have made a find that none of the rest of us know about. All comments are solicited, but if you ask questions, be sure to include a SASE.

The IEEE show in New York provided the opportunity for visiting a bit with most of the semiconductor manufacturers. They had many new items on display. Many were very sophisticated (and expensive!), but others were quite reasonable and of immediate interest to all hams. One significant trend is to very inexpensive transistors for consumer uses. It's about time; until fairly recently, transistors were used for entertainment only in the ubiquitous portable radio. Hi-Fi equipment was the next field conquered. Now portable TV sets are becoming very popular and the American semiconductor manufacturers are rushing to bring out suitable cheap high performance transistors for TV. Most of these devices are good and inexpensive, but not the ultimate. They'll match a 6BS8 or 6CW4, but not a 416B. The easiest (?) way to make transistors cheap, of course, is to make lots of them. Thank goodness for the broadcast receiver industry. Another way to make transistors cheap is to substitute inexpensive, non-critical, plastic or epoxy cases for the expensive hermatically sealed, environment-proof, mil spec metal cases. Here are some of the interesting new economy transistors:

From GE: Silicon planar economy transistors in a small plastic case about 1/5 x ¼ inch with three inline leads. Bulletin 45.01 describes the line. A few examples: 2N3663 has an f_T of 1100 mc, a "typical" noise figure of 4 db in TV rf amplifier service, and a price of 83c in large quantity. The 2N3721 has an f_T of 120 mc and only costs 20c in quantity. For transmitters, the 2N3405 has 900 mw dissipation, 50 volts BV_{CEO} and f_T of 150 mc. Price is 52c in quantity, and either $1.25 or $2.08 apiece singly depending on where you look.

Texas Instruments has a line of germanium epitaxial planar transistors that promise many ham and commercial applications. Numbers are TIXMO1-08. They are encased in a new glass and plastic package with standard lead arrangement. Prices go as low as 30c. Among the advantages TI claims for the transistors are very low noise figure, guaranteed forward AGC characteristics, low feedback capacitance to eliminate need for neutralization, minimum detuning with AGC, and the package. Incidentally, extensive tests show that the package is very reliable and long-lasting.

Other manufacturers are also working on these economy transistors. Let's hope that they find their way into ham gear in not too long and replace those old tubes. Incidentally, I've been using the fabulous new Davco DR-30 receiver. It's what receivers have been working up to for these 50(?) years. Make sure that you find out all about it; it's a fantastic piece of gear, and considering its features and quality, should sell for twice its price.

Not all of the new transistors are cheap receiving types. TI has a new one (TIXS12) for microwave use. It oscillates up to 2500 mc (2.5 Gc) and puts out ¼ watt at 1.5 Gc. Cost is a bargain $1080! Other new TI transistors are the 2N2876 ($49.50) for ten watts at 50 mc and three on two, and the 2N2631 in a TO-5 case ($33) for 7.5 watts on six.

RCA has the 2N3632, 2N3553 and 2N3375 epitaxial silicon planar types for class A, B and C amplifiers, frequency multipliers, and oscillators at VHF and UHF. The 2N3632 will put out about 14 watts on two in unneutralized class C service.

RCA has also come up with some transistors specifically designed for use in 117 vac broadcast sets without low voltage transformer. Since most radios are used in buildings with AC power, why bother with batteries. The 40261-40264 transistors and 40265 rectifier provide excellent service from a four transistor circuit instead of the standard six transistor line-up of low voltage sets. They are also good in phonographs.

Bendix BIG rf silicon planar epitaxial transistors show a rating of up to 20 watts out at 50 mc. Typical numbers are 2N3619 through 2N3630.

TRW's (formerly PSI) new PT4690 puts out six watts from 28 volts at 400 mc with an efficiency of 40%. At 250 mc, output is eight watts with 8 db gain (1.7 honest watts of drive) and 70% efficiency. Cost is about $38 in 100-quantity.

Write and tell me what you want in the column.

. . . WA1CCH

Here is a simple set and forget code monitor for those Novice and General brass pounders who operate the popular grid block keying transmitters

Jack Bruce WA6UV
Box 259, Route 3
Carmel, Calif.

The Litts Code Snitcher

A few months back, friend and neighbor Dean Litts acquired for himself a new call, WV6YOV, an almost new DX-60, and an old but suddenly active set of nerves. Shortly thereafter on a visit to observe operations at the new shack I found friend Dean groggy, jumpy and determined as he pounded brass, twitched dials and strained to make sense out of the dits and dahs pouring out of the receiver. He had but one specific complaint, however: the necessity for retuning the receiver each time the QSO was "turned over." Most Hams, of course, will immediately recognize this problem. I must confess I didn't. Starting with a "General" and a sidetone transmitter I have always regarded a code monitor as strictly a gadget for tinkerers—until now. Herein, then, is an accounting of fun and education in designing a surefire monitor for the popular grid block keying transmitter.

There are two main problems associated with designing a good code monitor. First, fo a pleasing tone, a good sine wave must be gen erated; secondly, the sine wave must be keyec correctly and without disturbance to the key ing circuits of the transmitter.

I researched the published literature on th subject. One author advocated breaking th grid resistor from ground and inserting th key at this point; this for grid block keyin only. This arrangement produced some of th most sickly sounds this side of Doctor Be Casey. Actually the results are understand able since cut-off of the tube is controlled b the value of the grid resistor through whic the blocking voltage must pass; the larger th resistance, the slower the tube is forced int cut-off, and vice versa.

All the other literature concentrated on th principle of rectifying rf from the tank or an tenna line and amplifying to either earphon or loudspeaker volume. The trouble with thi

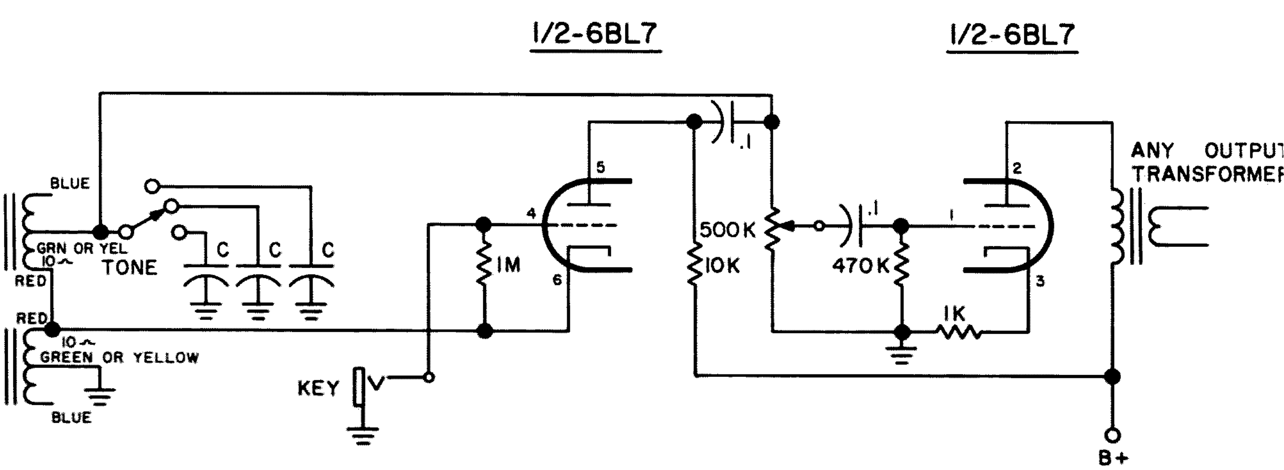


FIGURE 1

atter arrangement is that there are too many oose ends flopping around. For example, :loseness of the pick-up coupling loop versus requency.

Salvation of the situation rested in using a imple LC oscillator circuit in which the grid of the oscillator tube was at ground potential luring operation and considerably above ground when in the standby position. This urrangement assured no interference with the ransmitter circuits during "key down" and naintained the transmitter final at cut-off with he key up.

Fig. 1 shows the final arrangement of the initcher developed after many circuit changes. The final product is as bare of frills as posible. The only difference from a basic oscilator circuit is that the grid is keyed to ground, while the inductance coil feedback ap is connected to cathode and is above ground.

The grid resistor performs two purposes. The first is naturally to bias the tube. The econd purpose is to keep the grid block voltage of the transmitter at approximately its original value before attachment to the montor. Something between 100K and 1 meg will suffice. Actually the best waveform, and onsequently the best tone, is obtained with a ery low value grid resistor, but unless the nonitor is to be used exclusively as a code practice oscillator, anything less than 100K will be impractical. The tank capacitor should ie chosen to suit the ear of the user; decrease : for a higher tone and increase for a lower ne.

The inductance coil (LI) is the chief ource of the good waveform. Almost any two oils of approximately the same inductance will work if connected in series. My unit worked quite well using two television vertial output transformers. These are readily vailable from old receivers. Select those of he auto-transformer type and choose two whose resistance between two of the leads is 0 ohms or less. Connect them as shown in Fig. 1 and wrap off the other two leads. It will e necessary to try a variety of tank capacitors to find the right combination because ie inductance of transformers will be unnown.

The nicest thing about these devices is that hey almost always work; the fun lies in making them work better.

Dean Litts no longer grumbles amid his its and dahs; his Snitcher stays with him wherever he moves.

. . . WA6UVS

New Books and Literature

TMC SSB Handbook

In 1962, the Technical Material Corporation began a factory training program for their field engineers and customers. Out of this program grew the *SSB Handbook* by William P. Henneberry. This book covers the field of SSB carefully and completely. It was designed as a textbook, so is ideal for home study by novices and a reference for experienced engineers. Chapters: Introduction to SSB, Review of AM, Elements of SSB, Types of SSB Operation, Nature of SSB Signals, Distortion in SSB Transmitters, Balanced Modulators, Linear Amplifiers, Filters, Frequency Synthesis, SSB Receivers and Converters, The *SSB Handbook* is hardbound with 210 pages and many photos and drawings. Price: $10. TMC, 700 Fenimore Rd., Mamaroneck, N. Y.

Zeus Catalog

The Zeus Portable Generator Co. has released a new comprehensive general catalog of its alternator-type electric power generators and accessories. A total of 14 different models from 1000 to 300 watts, including two new propane powered items, are listed. The catalog also describes describes 12 new accessories and options. All of Zeus' power plants are built around a permanent magnet alternator with only one moving part. This reduces weight and reliability considerably over conventional generators. Zeus also has available a series of charts showing the power required to operate various tools and appliances. Write to Tom Creighton, Zeus, 12435 Euclid Ave., Cleveland, Ohio.

Charts and Nomographs for Electronics

Solutions to hundreds of electronics math problems the easy way can be found in the new *Charts and Nomographs for Electronics Technicians and Engineers* by Donald Moffat and published by Gernsback. It will save you time and effort in any problem in every field of electronics. All you have to do to find a solution to your problem is turn to the proper page, slide your ruler in place and read the answer. You don't have to mess around with a slide rule or wear out your brain. Examples are even provided for each chart. The book is a large 8½ × 11 and is spiral bound to lie flat. It contains 96 pages and costs a reasonable $5.95. Gernsback Library, 154 West 14th Street, New York City.

Cush Craft Catalog

Cush Craft has out an attractive new catalog listing all of their amateur antennas and accessories. Included are yagis for 20 through 432, portable beams, collinears, Squalos, Big Wheels, halos, Twists, and ground planes Make sure that you get this catalog from your distributor or from Cush Craft, 621 Hayward Street, Manchester, N. H.

1965 EICO Catalog

The new 1965 EICO short form catalog features many new EICO kits. EICO has many kits in the Hi-Fi, service and general fields of interest to most 73 readers. Their ham gear is particularly interesting. A new item is the only three band SSB transceiver kit In all, over 90 items are fully described in the 48 page catalog. You can get you copy at your local distributor or from EICO at 131-01 39th Avenue, Flushing, N. Y.

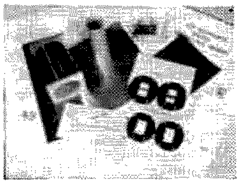
Sams Transistor Spec Manual

You don't have to work with transistors very much to find an interesting fact: unlike the popular tube manuals put out by manufacturers, transistor manuals usually list only those transistors made by the company. Consequently, it's often very hard to find data about a specific transistor. The new Sams *Transistor Specification Manual* gives complete electrical specs, basings and outlines for over 3500 transistors. A useful section lists older transistors with new type numbers. If you work with semiconductors, you need this book $2.95. Available from your distributor or from Howard Sams, 4300 W. 62nd St., Indianapolis, Ind.

GE Tube Manual

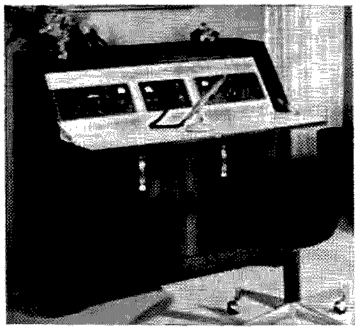
The eleventh edition of General Electric's *Essential Characteristics,* a digest-sized 320 page manual is now available. It contains a wide range of information on receiving tubes special-purpose tubes and some other GE products. The manual provides information on virtually any tube you're likely to run into One of its special features is that the basing diagrams are arranged across the separately hinged bottom portion of the pages so th data on any tube can easily be matched with its base. *Essential Characteristics* is available from distributors or by mail for $1.50 from GE, Dept. B, 3800 N. Milwaukee Ave., Chicago, Ill.

New Products



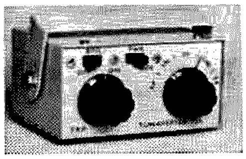
Ham TV Camera Kit

There's no excuse any longer to put off getting on ham TV. ATV Research has done the difficult part of the work for you. Their model 65A Focus-Deflection Coil Kit furnishes all of the special hard-to-make parts for your camera. Included are machine wound focus and deflection coils, shielding materials and a shielded vidicon target connector. Assembly of the coils takes less than one hour. Included with the kit is a 16 page Vidicon Camera Construction Manual with complete instructions for building a straightforward 5 tube TV camera that uses standard, economical parts. Price is $16.95 ppd. Write to ATV Research at P.O. Box 396 in South Sioux City, Nebraska, for more information.



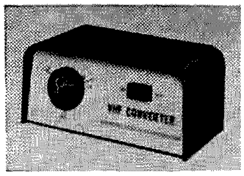
Design Furniture

Are you tired of having to leave your beautiful ham gear on an old table in the basement because your unesthetic wife thinks it's ugly and won't let you bring it upstairs? Design Industries has come out with the solution to your problem. They make beautiful wood-finished equipment consoles that will soften the hardest wife's heart. The furniture is on casters, the front panels are easily replaceable for new gear, and the doors have locks to keep out sticky fingers. Our photo doesn't do them justice; get an attractive four color brochure from Design Industries, P.O. Box 6825, Dallas, Texas.



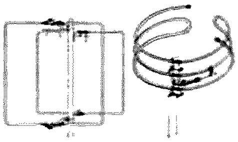
Tunaverter

No, there's nothing fishy about this one. It's Tompkins Radio Products' tunable converter for any single ham band (or special frequencies). The Tunaverter uses vernier tuning, tuned antenna circuit, printed circuit board, gimble mount, and an inexpensive nine volt battery. There are a number of different models including BFO's and a choice of 262 kc, 455 kc and 800 kc output, so write to Herbert Salch and Co., Woodsboro, Texas for more information.



New VHF Converters

Scientific Associates has brought out some new VHF transistorized converters. One is crystal-controlled and covers any one-mc segment from 108 to 170 mc. The other is tunable over a band of frequencies in the range. Both models include audio squelch, a tuned rf stage, and a tuned mixer and feature instant switching from regular BC to VHF. Size is only 5 x 3 x 2½". Price is under $40. Scientific Associates, P.O. Box 1027, Manchester, Connecticut can send you more information.



New 2 Meter Antennas

Hi-Par is making some interesting new 2 meter antennas. One is a halo that is three half-wavelengths long. Two of the half wavelengths are in phase and the other provides matching. Use of the extra section provides gain over a single ring halo. The other antenna is a two meter quad. It is completely factory assembled so that you only need to open it up and tighten a few nuts for use. Sounds good for portable operation. Contact W1LKQ at Hi-Par, 347 Luenburg St. in Fitchburg, Mass., for more information.

73 Books

Peterborough, N.H.

—CARE AND FEEDING OF HAM LUBS—K9AMD.—Carole did a thor- ɹgh research job on over a hundred ɔm clubs to find out what aspects ent to make them successful and hat seemed to lead to their demise. his book tells all and will be in- ɔluable to all club officers or any- ɪe interested in forming a successful ɔm club. **$1.00**

—SIMPLIFIED MATH FOR THE HAM- HACK—K8LFI.—This is the simplest ɪd easiest to fathom explanation of hm's Law, squares, roots, powers, equency/meters, logs, slide rules, etc. our schools ever got wind of this nazing method of understanding ba- c math our kids would have a lot ss trouble. **50c**

—REVISED INDEX TO SURPLUS— /4WKM.—This is a complete list of /ery article ever published on the ɔnversion of surplus equipment. Gives brief rundown on the article and ɔurce. Complete to date. **$1.50**

—SURPLUS TV SCHEMATICS.—You ɔn save a lot of building time in TV you take advantage of the real ɔrgains in surplus. This book gives ɪe circuit diagrams and info on the ɔpularly available surplus TV gear. **$1.00**

7—AN/ARC-2 CONVERSION.—This transceiver sells in the surplus market for from $40 to $50 and is easily converted into a fine little ham transceiver. Covers 2-9 mc (160-80-75-40 meters). This booklet gives you the complete schematics and detailed conversion instructions. **$1.00**

12—CW—W6SFM.—Anyone can learn the code. This book, by an expert, lays *in a good foundation for later high* speed CW ability. **50c**

14—MICKEY MIKER—WØOPA.—Complete instructions for building a simple precision capacity tester. Illustrated. **50c**

15—FREQUENCY MEASURING—WØHKF —Ever want to set yourself up to measure frequency right down to the gnat's eyebrow? An expert lets you in on all of the secrets. Join Bob high up on the list of Frequency Measuring Test winners. **$1.00**

RECEIVERS. K5JKX.—If you want to build a receiver or to really understand your receiver, this is the book for you. It covers every aspect of receiving in author Kyles usual thorough manner. **$2.00**

ATV ANTHOLOCY. WØKYQ and WA4HWH.—A collection of the construction and technical articles from the ATV Experimenter. Includes c complete, easy to build vidicon camtra and 50 other projects. The only book available about ham TV. **$3.00**

PARAMETRIC AMPLIFIERS. WA6BSO. —Parametric amplifiers are probably *the most practical way for hams to* get a low noise figure at VHF and UHF. This book is the only one available that covers both theory and practice. **$2.00**

TEST EQUIPMENT HANDBOOK. W6VAT.—Every ham needs to have and know how to use test equipment. This book tells you how to make valuable ham test gear easily and cheaply. It also covers the use of test equipment. **50c**

HAM-RTTY.—This is the most complete book on the subject. Written for the beginning TT'er as well as the expert. Pictures and descriptions of all popular machines, where to get them, how much, etc. **$2.00**

Babcock Band Filter

Babcock has announced the new Model ɜ-3234 Solid-State Band Filter that is used to nprove performance of existing transmitters nd receivers. It increases the talk-power of SB transmitters by up to 12 db while re- lucing the transmitted bandwidth. Speech in- elligibility is improved to aid in penetrating ɪeavy QRM. When receiving, a steep-skirted djustable bandwidth mechanical filtering sys- em removes QRM that a fixed selectivity re- eiver would pass. T-R switching is automatic. Ͻnly three connections to your equipment are ɪecessary: transmitter mike jack, receiver head- ɔhone jack and transmitter accessory jack for witching. A 455 kc SSB output jack allows the ɪnits to be used as an SSB generator. AC and ϽC power supplies are provided. $319. L. E. ɜabcock and Co., 85 Nob Hill Drive, Framing- ɪam, Mass.

Letters

advised by my lawyers that
don't you ever proofread y
are bunch of crooks and
this is the last straw for
have no other recourse but
should be tarred and feath

Sic

Mr. Green Attn.:

In pertaining to your article of November 1964 concerning our Kentucky DXpedition on page 90, I would like to comment that one certain sentence is a low down dirty lie deliberately defaming my character!

The article stating that I was kicked in the slats *IS NOT TRUE* and is a willful deliberate lie and there are witnesses who can prove this fact!

It was Alan, not I, who instigated that incident on our trip and he was the one who got into a fight and not I!

I don't know how that article got into that editorial but I have a pretty good idea who did it. Alan's picture is on the far right!

In the first place, the Hammarlund Co. put a ****** ****** in charge of the trip by the name of Alan Day K8ITM! And the trip should never have got started!

I hate to do things like this Mr. Green, believe me, but my reputation is at stake here and I am *not* the troublemaker that Alan is!! Believe me I was in strong debate as to what to do about this and several friends of mine told me I should write you about it! They told me I would be a fool if I didn't!

You don't know half the story about that trip pertaining to the things Alan got away with and tried to get away with! i.e., trying to get me into trouble with the law!! Furthermore he was going to blame it all on me!!

I wanted to back out of the deal since I heard some bad things about Alan but he and his father *forced* me to go!! They are from Canton, Ohio.

I *Demand* a retraction and rectification of that false statement printed about me, I *demand* that *you give* me a *free* copy with that rectification in a later issue of 73 within the next couple of months! I *Demand* my share of the royalties printed in that article since Art and I did most of Alan's dirty work!!

If *you* do not wish to cooperate with me I shall *sue you* personally Mr. Green and I mean business!! *People just don't like lies printed about them no matter what the cause may be!!*

How would you like it if you were the object of a character defamation?? This hurt me whether you know it or not Mr. Green! But anymore it seems that people don't care who gets hurt! I would furthermore advise you to pre edit any further material you print. I also would like to assert that for the most part these people were most congenial, hospitable and much more honest than Alan! In conclusion after doing most of Alan's dirty work Art and I didn't even get to use the rig!!

Paul D. Keller K8EJN

Dear Wayne,

This is an emergency. *Popular Electronics* sent a petition to the FCC for a codeless ham bands to get the rag chewers etc. off 11 and put them on 2 meters. This would be a Communicators License according to *P.E* For reference see January and November *Popular Electronics.* Please let me know how this strikes you. It strikes me sickening. We're losing enough frequencies now without having to lose our VHF frequencies.

Darwin Hansen WAØHAY
Belmond, Iowa

You are absolutely right Darwin, we don't want any codeless hams on our bands. All of us had to suffer through that process and we want everyone else to have to go through the same thing. Sure, I know, half of the active hams never have to know the code once they get their license . . . but just think, suppose we had a war and all the Teletype machines and microphones were destroyed . . . we wouldn't be able to communicate without code. Let's keep that there code.

Hi Wayne—

I have a question for traffic handlers—so wonder if you can throw this one into the mixer and see what comes out?

Before you read this particular question I'll have to say I can't really sign it—if I do I'm a disgruntled so and so—or a rat fink—or disloyal (to who? I mean to whom—or do I?) So, if you don't think anyone can shed any light on it, throw it into the round file (like some of the traffic). By the way, I wrote another leading magazine this same tale of woe and I didn't see it in print—(I guess because I didn't sign that letter either) I'm a subscriber to the two leading magazines—73 (see, I put you first!!!) and QST. (Don't take offense, Macy's mentions Gimbels) That third mag I let go, it was too wishy washy.

Okay, I'll get down to my state of puzzlement.

That BPL list that comes out in that other magazine? Are they all one operation stations? This is something I can't possibly understand and I wish some one could help me figure it out. I'm the kind of a person who checks the electric co bills and the oil bills to make sure I'm being charged the proper rates. (only about once a year, tho)

For instance, let's start at the top of the list for the month of December—here's a station with a total of 9802 pieces of traffic—originations 544—Rec'd 4669—Rlyd 3797—Delivered 792.

First I figured out the time values (estimated, of course) for delivered traffic. I have delivered traffic—most messages have no phone numbers so you look them up or call information—most of those with phone numbers are wrong anyway, so again you look them up or call information—when you finally get to call them it takes time to dial, half the time there's no answer or its busy—finally you get an answer, explain yourself, deliver the message, accept thanks, sometimes you have to wait and be told what a wonderful thing to do—average 4 minutes per message, total time 52.8 hours for 792 messages. (and if you can't reach them you must write it up and mail it)

Next originated—even a service message takes at least 2 minutes to write up. When someone calls with a message it takes anywhere from 5 to 10 minutes after introductions, finding the correct address, thinking just what to say—let me be generous again and say 4 minutes per—39.3 hrs for 544 originations.

Now, Received & Relayed. Good clear band, lots of power, no QRM, no breakers (who may be in the same town tfc is going to), standard texts (very small percentage and should be counted as 'book' traffic, anyway, and usually isn't), necessary fills, possible discussion about garbled name or address—lets say 3 minutes per, 4669 & 3797 messages total 423.3 hrs. This comes out to an estimate of a possible operation time of a Grand total 515 plus hours per month, broken down to 30 days for the month of December means 17 hours of full operating time (I allowed one day off for Xmas)

As I look at this awesome total I begin to wonder—does one have time for such everyday good health habits as eating and sleeping, etc, or daily necessities like food and family, or a simple little headache, or separating & sorting messages to reroute them in the proper direction to their destination? Then after all that is done, how does one sort time and count them without collapsing from mental and physical exhaustion?

Y'know, if someone gave me 9802 dollars in one dollar bills I'd take their word for it and not count it! How does one count all those Recd & reld, Recd & Delvd, Rcvd & QTA, Orig. Me oh my! It takes hrs. And where does one store these for a whole year?

I checked the call book to see where that station is and I looked on my road map and it isn't even listed altho I finally determined it is near a very large city area. Still, 792 messages are a heck of a lit of messages for delivery from one station in one month. Forget I wrote that—I'm too rotten a typer to rewrite this and my two fingers are about worn out.

So, you see, that's my question????? Using this top station as an example, can this possibly be done by one operator?

Didn't that operator go Xmas shopping or send out Xmas cards?

L. T.
Ann Arbor, Mich.

ear Wayne:

I have just finished reading "The Amateur and Civil efense Emergencies," page 58 of the February edition of }. We need more of this type of article to motivate nateurs toward emergency service. I am in the military ıd a member of MARS and know only too well what ı emergency is and what a backup means of emergency ımmunications can do. I have been in the amateur serv-e the last five years: I am sorry that I didn't think of sooner. I also have over twenty years in the com-unications business.

I have a few remarks to make after reading Homer aston's (W5CZ) article. I found it very well written, ;pecially concerning RACES, etc. Why can't a frequency · frequencies within the amateur bands be designated ır an emergency? Let's say 10 kc or so on the lower or pper end of each band be reserved for emergencies. This only an idea, and comments are invited. How about system such as the Marine service uses? Whatever is lopted as far as amateurs are concerned would be an ıprovement and I believe would greatly benefit the nateur service as far as the public is concerned.

In reference to the ARRL's recent proposals, I do not together go along with them, but I do believe we ıould make a change of some sort, such as eliminating ıe novice and technician license and making some pro-ision for training only in the one watt class. Some uropeans have this system, and it works real well. In :ference to CB, made by Mr. Gaston, I do not believe B will ever be able to replace amateur radio as an nergency service.

In closing, I would like to say, "Wake up, amateurs!)on't sit back and let the C.B.'ers do your job. We are a ɔecial brand of radio men, so let's prove it to the nation nd to the world!"

Walter Evans WØASH/DL4PJ
Wurzburg, Germany

ir:

I know it is more or less useless to write ARRL bout this matter. Would be of no use anyway.

My problem is this. ARRL specifies a certain size nvelope to be sent to their QSL bureaus. This envelope ; of such a size that 1/3 or more is excess and un-ecessary. So what does the P. O. do? They fold over he excess, causing the envelope to split open quite often. 'he recipient of the split envelope never knows if he eceived all the cards the bureau put in. I very often eceive envelopes from the bureau where the envelope ; completely in two parts and tied together with string.

This is not necessary. The high up "Fathers" at ARRL-hat-have-charge of setting policy on envelopes to be sent o the bureaus should decide on an envelope size 5" x " and have the QSL bureaus turn the envelope up the arrow way with flap open. Further, an envelope this ize will take all QSL cards except very unusual ones nd you would receive your envelope intact from the ıureaus.

I'll never know how many rare QSL's I have lost to the '. O. in transit in those number 10 envelopes.

Leander J. Smith W7UVR
Kennewick, Wash.

)ear OM:

Why doesn't someone publish a breakdown book on nilitary surplus. There's more and more new stuff :oming up all the time, but what is it and what is it ;ood for? No one seems to know but maybe the guy that s peddling it and in a lot of cases even he doesn't know ınything about it but price.

Sam Main WØHQW
Grand Rapids, Minnesota

iam, I've been trying to sell you the book you described 'or three years now. Our Index to Surplus lists every ɔiece of equipment that has been written up in any radio magazine and is quite up to date. $1.50 from 73, Peter-borough, N. H.

6146B

Dear Wayne:

I've been reading 73 for almost two years now, and don't thing I've ever seen an RCA ad yet. The back cove of every QST has one—I don't know about CQ; neve touch the stuff—but none in 73. I was somewhat astor ished, therefore, when you paid for a full-page RCA ac and a misleading one, at that.

I am referring, of course to the article "Easier Highe Power" in the March issue. This article contains nothin that the RCA full-page 6146B advertisements do no

Why do I call it misleading? Think of the power gai in decibels and you will see. The db formula is 10 lo (P2 ÷ P1). This works out to a power gain of 10 lo (1.33 ÷ 1) db or, at the most, 1.25 db increase. At six d per S-unit, this comes out to .28 S-units higher than usin plain old 6146's. And although the power gain will in crease when you use two or more tubes in the final, th ratio of powers, and thus the S-unit increase remain the same. I'll stick with my 6146.

Mike Prager K1VSI
Providence, Rhode Islan

They'll never advertise now.

Dear Wayne:

Now here's a thought that just might make you som money.

There is an impression in ham circles that the 6146l is an RCA exclusive. This is mostly because of th power of advertising—let's face it—on the back page c you know where.

I was recently at a meeting with some people fror the Sylvania factory, and they were very sensitive abou the fact that people in the commerical field didn't seen to be aware that Sylvania made a 6146B which Sylvani claim is even better than the RCA version.

The article by K9FWF tends to perpetuate the myt of RCA exclusivity.

I suggest you approach Sylvania with these facts, an show them that a series of full page ads in 73 devote exclusively to the 6146B and possibly some of thei wonderful new frame-grid tubes with fantastic Gm, migh off-set the unfortunate impression which RCA has man aged to create.

Bob Eldridge VE7B
Vancouver, B. C.

Dear Wayne:

Enclosed is a postal money order for my subscription Hope it's in time for the mailing of the February issue 'cause even as good as 73 is, I'm tired of driving a hun dred miles for a copy!

I don't know when I've enjoyed a magazine so much Your staff is to be complimented for being able to draw together so many interesting and informative articles. Wit my strong interest in building, but with limited ability t understand, I find a wealth of ideas expressed in languag which doesn't take a degree in engineering to follow.

The purpose of this letter is not to knock things (o publications), but I can't help but note how nice it i to see a magazine *not* made up of monthly traffic reports contest results, and such. Keep it up!

Merton D. Short W4JRJ

Dear Wayne:

Your very fine magazine came to my attention las December. Might I mention a few features of 73 that I find to be outstanding: Heavier paper stock; glossy finish articles not continued at the end of the magazine; page t price ratio (Feb. CQ 28 pages shy, QST 1 page); open and lays flat while reading or building; items like "Th Callbook Game" . . . more!; the editorial is worth th price of the issue on its own merits; but above all I appreciate the well written features, the lay-outs and th up-to-the-minute information in regards to the amateu ranks. Some other points that enhance 73 are: authors ful name and address given; advertising mixed throughout th magazine with the articles; most articles written, teste and explained by hams.

Joseph Gaudet
Haverhill, Massachusett

)ear Wayne,

Many thanks for the fine articles you publish in 73. 'his is one of the most progressive magazines for ama- eurs that I have seen. I am a so-called "Charter Sub- criber" and will continue to renew because of the fine ontents of 73.

I have some info on telephone toroids that might be ›f interest to the Teletype gang. The list gives the WECO ›art or coil numbers, inductance in millihenrys (with the oils connected series aiding) and resistance of each oil per line winding (½ total resistance wired series iding).

'oroid #	Inductance	Resistance per Line Wiring (ohms)
632	.088	4.2
638	.044	2.3
639	.022	1.1
641	.044	2.8
643	.135	4.5
644	.175	6.3
645	.250	9.4
651	.044	3.8

Also Wayne, I have the resistance and impedance ratio ›f the 120 series Repeat Coils. They are quite nice for ›atching and matching.

₹epeat 'oil #	Term 1 & 2	3 & 4	5 & 6	7 & 8	Impedance Ratio
120C	7.8	5.5	7.8	5.5	1 to 1
120D	12.7	5.5	12.7	5.5	1.5 to 1
120E	5.0	5.5	5.0	5.5	1 to 1.5
120H	7.8	5.5	7.8	5.5	1 to 1
120J	12.7	5.5	12.7	5.5	1.5 to 1
120K	5.0	5.5	5.0	5.5	1 to 1.5

I hope this info can be of use to you and the group. I have a quantity of the 632 88 mh and 638 44 mh oils in stock if for any of your future Teletype articles 'ou would like to have a known source to mention. 50c ach for the 44 mh and 75c each for the 88 mh.

W. O. Depelheuer W6GTE
R R 1 Box 145
Ellisville, Mo.

)ear Wayne,

I would like to take this opportunity to voice my ap- ›roval of your battle against the "Powers That Be" in Newington. RM-499 is just so much QRM plus QRN nd I feel it is now entering the QSB phase—I hope. ARRL appears to be working two ends against the middle. t seems obvious that with RM-499 at one end, they are ttempting to eliminate many fone operators for the ›enefit of a few, while on the other end they are spon- oring all kinds of aids and encouragements to induce ›ewcomers to hamdom. They cry loudly for "upgrading" o "preserve" our frequency privileges which of course neans they think us hams should knuckle down and lelve into all the theory books we can get our hands ›n, or get the heck off the air! But on the other end gain, they are supplying books saying how easy it is o become a ham. A glaring example of their inconsistency s the cover of their latest edition of the "Radio Amateur's License Manual." A large illustration on the cover indicates *'all you need to know—in a nut shell,"* while in the the ackground is shown a group of what purports to be eal solid study books—but ARRL puts a big black ross on these to indicate they are not needed—no—just ›uy their License Manual for 50c and you're in business!

WB2FKZ
Ballston Spa, N. Y.

)ear Wayne:

At the time I submitted the original manuscript for nay article, "Improved Halo Mount," which appeared n page 84 of the March, 1965, issue of "73," I was still lugging up the mount with an old champagne bottle ork whenever going through the automatic car wash. Hesitating to mention this I made no specific recom- nendations. In the meantime, however, I found a stand- rd size crutch tip caps the mount nicely whenever the ntenna is removed. They're cheap and readily available t most hardware stores in both black and white.

Jack Ayres K3JZH

W2NSD/1 from p. 3.

should all give the League a rousing cheer (Bronx) for coming up with such a winner. If they do as well for us with the FCC we can turn to stamp collecting.

Good Old Oscar

Along early in March I began to suspect that they really might get that overgrown shoebox into orbit. I think they really hit home when the Oscar III crowd answered my request for launch data or perhaps a collect phone call with a particularly evasive letter, telling me to listen to W1AW like everyone else. Judging from the almost complete lack of public press coverage the committee for Oscar III must have given the rest of the press the same brush-off I got.

So here we are with an operating amateur radio satellite. This should be one of the biggest news stories yet . . . and through unbelievable negligence the story has not been told. This is another clear indication of the immediate need for a change of leadership at ARRL HQ. ARRL Director Howard Shepard was in charge of Oscar III. To date . . . some three weeks after the launching, I have not had one single news release from ARRL, or the Oscar III Committee. Great, eh? I'll leave it to you to project this adept handling of key amateur radio publicity into the international amateur situation.

When I realized that O3 might be up at any minute I called Cushcraft and got them to stop making Squalos for a few minutes and whip up a 22 element Multi-Polarized Twist antenna for me. It arrived a couple days later and my first inclination was to put it up on 73 Mountain on my 120 foot tower. Then I got to brooding about hearing Europe and the ridge to the east which would probably block such goings-on. The result of this was that we installed it at the Hq shack in Peterborough.

O3 went up on the 9th of March and my antenna went up on the 13th. This is about par for me. While Dave WA1DUN and Barry K2YDD/1 were getting the antenna up, Paul WA1CCH and I turned our attention to the rest of the gear. The receiver was easy . . . a converter into my NC-300. The transmitter was more of a problem. A new 826 got my Gonset 2M linear working again (those darned tubes cost over $4 now . . . and they used to sell for 30c!) . . . I also siliconized the power supply so I wouldn't have to worry about 5U4's any more. Four of Meshna's bargain 1000 PIV units worked fine.

I suspected that the 100 watts suggested by O3 Committee was a bit dreamy so I started modernizing an old 500 watt 2M rig (from the W2BFD auction). Silicons in the power supplies . . . tracing out the control circuits . . . new meter panel . . . etc. After only minor catastrophies Paul and I had it perking just fine. One thing I could never understand is why those 4-125A's have to have about 50 watts of drive to work right when the Eimac data sheets call for about one tenth of that. I've never known anyone to get away with the rated input to the grids. I checked with the local FM servicing people and find that they do the same as I do . . . 50 watts drive.

So there we were . . . antenna up and ready to aim . . . converter dishing out beaucoup hiss . . . transmitter ready to grunt out gobs of rf. A short check of the band and I had all the data on the next few orbits from W1JZD. The first orbit was supposed to be very low to the east . . . great for hearing Europe. I didn't even hear the hi signals. On the next orbit, an hour and a half later, the hi's came in quite well and I heard a couple of relayed ham signals fade in and out . . . nothing I could copy. This was going to be harder than I expected. I tried horizontal polarization . . . vertical . . . right hand circular . . . left hand circular . . . horizontal and vertical together . . . all worked about the same . . . I think. I really couldn't tell much because the darned thing was fading in and out and I had to try to keep the antenna following it too. It suddenly became quite clear to me that I needed a lot more sophistication in equipment before I was going to do any serious O3 communications.

In the two weeks since that great discovery I have listened to many of the passes of the satellite and have managed to copy quite a list of calls . . . I've heard a few fellows managing two way copy . . . but very few. I hear Sam W1BU up here on a direct basis, though I've never heard his signal come through O3, and he seems to hear Oscar a couple of minutes before and after I do. I understand that he has had contacts with Germany and Switzerland. Some of the signals peak up to an S6 here, but most are S2 or worse. The most often heard are W8YIO, K2GUG and W8KAY. I have yet to send a dot.

Advertising

If 73 is just another ham magazine to you please skip over this part of the editorial. If you are interested in what I am trying to accomplish then lend me your eyes for a couple minutes.

A digression is obviously called for here. What *am* I trying to accomplish? Basically I

want to make amateur radio as much fun for everyone as I can. This seems to me to include my attempts at holding down the dictatorial behavior of certain ARRL officials . . . the formation of the Institute of Amateur Radio, and the inclusion of as much technical and construction material in 73 as possible Sure, I botch things up now and then . . . and you have to suffer along with exposures of ego, but for the most part I think we are doing what we set out to do.

The medium for all this is 73 . . . without it you are back to the few articles published in QST and CQ every month and *no* one to speak up when something rotten is perpetrated.

73 is paid for by the advertisers. Your subscriptions pay for us to mail you your copies and provide the readership which encourages the advertisers to advertise . . . but the magazine is paid for entirely by advertising. This means quite simply that the more advertisers we have the more magazine we can publish.

No doubt you've noticed that several of the larger manufacturers are not advertising in 73. There are several reasons for this. A few of the companies count their advertising results by the number of catalogs requested . . . and 73 comes out very poor on this because over 90% of our readers already have most of the

catalogs. I've been trying to interest them in selling their products rather than catalogs in the ads, but haven't done too well with this novel approach as yet.

That still leaves quite a number of major firms who are not advertising in 73 and I don't know for sure why they aren't. I do know that those companies who are advertising claim very good results. Some claim astounding results. Perhaps you can do something to help us in this matter.

If you mention 73 when you write for information to companies that are not advertising in 73 . . . ask them about it at conventions . . . ask their distributors . . . their manufacturers representatives. Let them know which magazine you want them to support . . . which one will get to *you*, their prospective customer. Let's see if we can get any one of the advertisers in the first pages of QST to support 73 . . . now *there's* a challenge for you.

There really aren't many logical reasons for not advertising in 73. Our rates are a lot lower than the other two magazines, one of which seems to have considerably less circulation than 73. Our results for most advertisers have been outstanding. How about a job as Assistant Advertising Manager?

Help! He Says . . .

Several readers have forwarded a letter to them by the Midwest ARRL Director. It makes morbid reading. "Frankly speaking, our amateur bands are going to be in more danger at the next international allocations conference than at any time in my memory." Then he goes on, frequently saying, ". . . the League's efforts to save amateur radio as we know it . . . to help save amateur radio . . . to help save the amateur bands . . . to help save amateur radio. . ." Then, "The ARRL has saved amateur radio on several occasions in the past . . . the ARRL can save it again with your help."

The ARRL has not, during the 27 years I've been a member, saved amateur radio from anything. Sure, Percy Maxim saved ham radio back after WWI, almost 50 years ago . . . but that wasn't any ARRL that I am familiar with and it seems to me that if that is the saving job they have been using on us all these years that it is just a little thin by now.

The most interesting thing to me is that an ARRL Director is writing exactly the same things that I have been criticized by the League paid management for writing . . . that we face a very threatening future. I doubt if anyone in the history of the League has ever been so personally maligned in QST editorials as I was for saying just that.

If enough Directors come to understand what we are facing they may possibly be able to communicate a sense of urgency to their paid management and get them to stop the deluge of actions which are so seriously hurting amateur radio. If they could but heal the deep wounds in IARU this would be a major step forward.

Executive Opening

The Institute of Amateur Radio, Inc., is looking for a full time Secretary to work at the 73 headquarters in New Hampshire and coordinate the activities of the Institute. He will be in charge of preparing mailings for Congress to keep our Senators and Representatives aware of the activities and value of amateur radio. He will investigate legal cases being fought by amateurs and help them with information and administer grants by the Institute to help fight important legal battles. He will work to implement the wishes of the Directors of the Institute. He will work to keep the membership informed through newsletters and the pages of 73.

This is one of the most important jobs in amateur radio today and the effectiveness of the man who takes on this job may have more influence on the future of our hobby than any

other single person. This position should pay $20,000 a year or more . . . no question about it. We are penny wise and pound foolish to try to put a boy in this man's job. But the Institute does not have backing of this magnitude at present so some compromise will have to be made. I suggest that this is an ideal job for a mature ham . . . one with good business background . . . possibly someone who is retired and doesn't need the higher income we don't have as yet. The Interim Directors of the Institute have agreed on a starting salary of $5000 a year, a sum which does enable one to live quite comfortably up here in economical New Hampshire.

If you are interested in working for the good of amateur radio . . . if you have the background to get this job done and done well . . . if you are free to move up here . . . please send a resume to the Institute of Amateur Radio, Peterborough, New Hampshire.

Institute Wins

The other night I got a call from Mace Warner WØJRQ of Denver. He was just back from court and wanted everyone to know that he won his case . . . a case that, if lost, could have had serious repercussions for all of us. At the instigation of a neighbor, Mace was being sued for $8000 because his tower and antenna were unsightly and devalued nearby properties. It should be mentioned that Mace lived there and had his antenna up before the suers moved into the neighborhood. There was no TVI involved in the case.

Mace was about at the end of his string, having spent close to $2000 on attorney fees and costs, when the Institute of Amateur Radio came to his aid and provided $500 which permitted him to carry the battle into the next court where he won the case. Mace said that he had given up hope and had about spent himself out when the Institute came along and gave him the incentive and backing to fight.

This is a real victory for ham radio . . . and a fine example of what the Institute can accomplish. How many of us are prepared to spend thousands of dollars to prevent a dangerous precedent from being set that could sweep hundreds of hams into trouble all over the country if lost? Battles like this should be fought with group funds . . . we all should pitch in to help in these fights which affect all of us. Only the Institute is carrying on this fight . . . have you joined yet?

Many amateurs are a bit hazy about amateur legal problems and believe that the League is active in supporting amateurs who

are fighting precedent cases. This is not true. The ARRL will on occasion provide legal advise to the lawyer that is on the case, but they will never and have never to my knowledge given one cent to help out the amateur that is in trouble. The Institute and *only* the Institute is sending cash money to help these court battles.

Calling Frequencies

Those of you who are on wide band FM or are thinking of it should give serious consideration to setting up on one national channel. FM nets have sprung up on a good many frequencies around the country . . . which makes it difficult fol fellows who are travelling around. Why not make the change this spring to one standard calling frequency on each band? The most popular ones are 52.525 and 146.94 mc. If your nets are not on these channels why not send out for crystals now and get set up with everyone else. In this way visitors will be able to call in while nearby and you will be able to talk to FM'ers in other areas when you're driving around the country.

Need a New One?

If you happen to be prefix hunting you might look for 4U-ITU with numbers 1-6 being used in rotation so that one station can give you six prefixes on May 16-17. Frequencies will be 1810, 1830, 3503, 3797, 7003, 7045, 14113, 14292, 21050, 21400, 28050, 28625, kc and 145.1 mc. It is just possible that you may hear me operating from there if I can make it and if they'll let me in.

Reciprocation

The FCC called the other day to let me know that reciprocal agreements have been completed with Bolivia, Costa Rica and the Dominican Republic so far. They ask that aliens please not apply for permission to operate until an agreement has been signed with their country. Many more are in the works, I know . . . about 35, I believe.

Little Trip

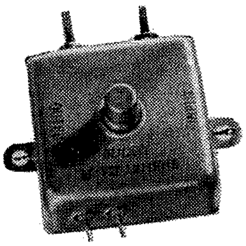
During May I will be visiting Europe. If you know any hams over there that I should visit you might drop me a line with their address. I intend to say hello to as many VHF amateurs as possible as well as officials of the radio societies. My trip will start at Frankfort and go to Stuttgart, Zurich, Geneva, Milano, Trieste, Zagreb, Budapest, Wein, Praha, Nuremberg, Hanover and Hamburg. I'll try to be on from 4U1ITU during their May 16-17th party.

. . . Wayne

BUDDY NUVISTOR PRE-AMP

2M - $9.95 6M - $8.95

★ Increases sensitivity up to 20 db.
★ Small size 2 x 2⅞" fits anywhere
★ Completely wired and assembled



★ Reduces images
★ Improves selectivity
★ Simply installed
★ CB model **$7.95**

Autronics Corporation
180 North Vinedo Avenue
Pasadena, California

ALL BAND TRAP ANTENNA !

Reduces Interference and Noise on All Makes Short Wave Receivers. Makes World Wide Reception Stronger. Clearer on All Bands!

For ALL Amateur Transmitters. Guaranteed for 600 Watts AM 1200 SSB Pi-Net or Link Direct Feed. Light, Neat, Weatherproof.

Complete as shown total length 102 ft. with 96 ft. of 72 ohm balanced twinline. Hi-impact molded resonant traps. (Wt. 8 oz. 1" x 5" long). You just tune to desired band for beamlike results. Excellent for ALL world-wide short-wave receivers and amateur transmitters. For NOVICE AND ALL CLASS AMATEURS! NO EXTRA TUNERS OR GADGETS NEEDED! Eliminates 5 separate antennas with excellent performance guaranteed. Inconspicuous for Fussy Neighborhoods! NO HAYWIRE HOUSE APPEARANCE! EASY INSTALLATION! Complete Instructions.
75-40-20-15-10 meter bands. Complete $15.95
40-20-15-10 meter. 54-ft. (best for swl's) Complete ... $14.95

SEND ONLY $3.00 (cash, ck., mo) and pay postman balance COD plus postage on arrival or send full price for postpaid delivery. Complete installation & technical instructions furnished. Free information on many other 160-6 meter antennas.

Available only from:

WESTERN RADIO • Dept. A7-5 • Kearney, Nebraska

MAY SPECIALS—POWER SUPPLY PARTS

Transformers, all primaries 117v 60 cycle.

2350v **NOT C.T.** 325 ma. cased, oil filled ceramic terminals. (30 LBS)	**$15.00**
900v C.T. 160ma (good for 200) potted cased, ceramic terminals (11 LBS)	**$4.50**
Pri 110. 120v. Sec. taps 0-800, 1000, 1200, 1400 & 1600 (or 1600 CT), 320 ma. open frame wire, color coded, leads. (26 LBS)	**$10.00**
Pri 110/120v. 750v CT (375-0-375) 170 ma; 6.3v CT 5A; 5v 3A. open frame, color coded wire leads. (8 LBS)	**$3.75**
Dual 2½v CT 9A (good for 12A), 1750v RMS test. Cased, hypersile core, ceramic termin. (8 LBS)	**$5.00**
2-8 hry; 600-10 ma; 25 ohm; 3800v pkW. Cased, ceramic terminals. (13 LBS)	**$5.50**
5 hry; 225 ma; 80 ohm; 400 RMS (1000v) test. Cased, solder terminals. (7 LBS)	**$2.25**

OIL FILLED CONDENSERS. All rectangular case.
8 mfd 1500v DC **$3.75**; 15 mfd 1000v DC* **$1.29**; 10 mfd 1000v DC **$1.00**; 4 mfd 600v DC **69c.**
5 mf 1000v **$1**; 6 mf 1000v **$1.25**; 4 mf 1500v **$1.95**
* take-outs-good. Others BRAND NEW.

SAVE YOUR LOOT. I'll have a wagon load of GOODIES at DeKalb, Ill. May 2; Rochester, N. Y. May 22; Pittsburgh, Pa. BREEZESHOOTER'S May 23.

All orders, except in emergency or I'm at a hamfest, shipped same day received. For free "GOODIE" sheet, send self addressed stamped envelope—PLEASE, PLEASE—include sufficient for postage & insurance. Any excess returned with order.

B C Electronics

Telephone 312 CAlumet 5-2235

2333 S. Michigan Ave. Chicago, Illinois 60616

CAVEAT EMPTOR?

★ Price—$2 per 25 words for non-commercial ads; $5 per 25 words for business ventures. No display ads or agency discount. Include your check with order.

★ Type copy on standard size paper. Phrase and punctuate exactly as you wish it to appear. No all-capital ads. Include your signature with order.

★ We can only accept ads related to ham radio. We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.

★ For $1 extra and an SASE, we can maintain a reply box for you.

★ We cannot check into each advertiser, so Caveat Emptor . . .

GOLD—You will find a "Gold Mine" in our used equipment. Write for list. W9KP—Green Mill Radio Supply, 145 W. 111th St., Chicago, Illinois 60628.

QRT COLLECTING; Selling antique wireless items and other stuff. What do you want? Free lists. Send large stamped addressed envelope. W6LM. P. O. Box 308, Wrightwood, Cal.

CONVERTERS $10 and up. World's largest selection of frequencies. Ham TV vidicon cameras and parts at low factory-direct prices. See them all now in our full page ad in this issue. Vanguard Labs, 190-48 99th Ave., Hollis, N. Y. 11423.

SONAR SRT-120P TRANSMITTER. 10-80 M, 120 watts, 100 watts phone, PPT, built-in power supply, 5984 final VFO-xtal. Excellent condition. Cost $300. Will sell for $100 complete. Box 151, 73 Magazine, Peterborough, N. H.

TELETYPE MODEL 30A PRINTER. Tiny light weight unit (19 lbs). Has 28 type keyboard, 115 vac motor, end-of-line indicator, aluminum case. Excellent condition. Just the thing for portable operation and demonstrations. $90. Box 152, 73 Magazine, Peterborough, N. H.

WIDE SCREEN TV CAMERA AND 18" MONITOR. Made by Crimson Color, Inc. Model 700. Sells for over $1000 new. Complete in excellent working condition. Like new with all cables, power supplies and manuals. $649. Box 153, 73 Magazine, Peterborough, N. H.

SX-101A. Excellent condition. Cost $445 new, asking $275. Will consider any reasonable offer. Jim Coulter K8HKQ, 191 Union St., Hillsdale, Mich.

POLAR RELAYS-WE-255. New, only $1.75 each postpaid. Teletype manuals—list available. National PWD gear drive—new, $3.50 postpaid. Quaker Electronics, P.O. Box 215, Hunlock Creek, Pa.

KIT WIRING done by E.E. for fun and $1 per hour. Top quality work, satisfaction guaranteed. Write Bob Groh WA2CKY, 9233 Main, Clarence, N. Y. 14031.

SELLING OUT MY ANTIQUE COLLECTION. tubes: VT-1 @ $2.50. Your choice @ $1.25: 00A, 01A, 12A, VT-5, Philco #2. Also W.E. 270A 500 watt antique triode, $4.00. Crosley 1923 Trirdyn receiver exc. $35.00. Samkofsky, 201 Eastern Parkway, Brooklyn, N. Y.

KNIGHT T-60 transmitter with 5 crystals. $35. Jesse Bryant, Box 829, Haley Rd., Kittery, Maine.

BRAND NEW NCX-5, original carton with NCX-AC power supply. $700. FOB N. Y. John Mrozinski WB2EXI, 155 Eckford St., Brooklyn, N. Y.

HE-74 VFO (new) $25.00; Heath Tunnel Dipper (new) $20.00; RF Panel, TR-SWR-SPKR-ANT-SW, 19" $10.00 Money order to W4BEX 1828 Highland Avenue, Eau Gallie, Fla. 32935.

FM RECEIVERS AND TRANSMITTERS for 2 m, 6 m and 432 mc bought, sold and exchanged. Motorola, GE, RCA, etc. Ray K8TJP, 2670 Pinetree, Trenton, Michigan. Phone 676-7460.

HEATH MARAUDER and Hallicrafters SX 111—$550. Homebrew 2 KW linear with all attachments—$150. Heath HG-10 VFO—$30. General purpose scope—$30. J. Michlin WA2WPN.

7TH ANNUAL PENN-YORK HAMFEST. Morrison's Restaurant, Big Flats, N. Y. (Between Elmira and Corning, N. Y.) June 19th, 12 noon. Grand award NCX-3 SSB Transceiver. Preregistration $4.50-$6.00 at door. Send SASE to Earl J. Foster W3BKF, Chairman, RD #2, Gillett, Pa. Last day for pre-reg June 12th. Speakers, swapfest, contests, etc. Smorgasbord dinner, all you can eat. Only 600 tickets available.

KISHWAUKEE RADIO CLUB SWAPFEST Sunday, May 2 at DeKalb, Illinois. Contact Alton L. Brand, 415 E. Sycamore St., Sycamore, Ill.

FT-243 CRYSTALS: $1 each for 2 kc accuracy, $2 for 0.01%. Air mail 10c extra each. Denver Crystals, 776 South Corona, Denver, Colorado 80209.

TRI-STATE ARA annual picnic. Camden Park, US 60 West, Huntington, West Virginia. 12 noon to 6 on Sunday June 6th. Displays, surplus, swap. Contact W8VA at 2937 Auburn Road, Huntington, W. Va.

FRESNO ARC HAMFEST. Saturday May 15. More information from Carl Massie WA6ZVY, P. O. Box 783, Fresno, California.

MISSISSIPPI VALLEY HAMFEST sponsored by the Quad City ARC at the Indian Bluff Forest Preserve near Milan, Ill. Wide variety of activities for hams and their families. Starts at 9 AM. For more information write W. M. Coopman K9CHZ, 911-23rd Ave., Moline, Ill.

HAM AUCTION, May 3. Check gear in at 6 pm, auction at 8. River Park ARC, 5100 North Francisco Avenue, Chicago, Ill.

BIRMINGHAMFEST. Sunday, May 1st and 2nd. More dope from Mike Thomason K4FQF, Box 603, Birmingham, Ala.

EASTERN WISCONSIN HAMFEST. Sponsored by the Ozaukee RC on May 15, Get more information from Harvey Goldberg, Box 13, Port Washington, Wisconsin.

SWAP FIESTA. Sponsored by the El Paso ARC. May 15 and 16 at the Mall of Bassett Center in El Paso. More information from Hurley Saxon K5QVH, 1501 Golden Hill Terrace, El Paso, Texas.

MOULTRIE ARK Hamfest. Sunday, April 25. Lynn Cunningham, 904 West Jackson, Sullivan, Illinois.

FREE! BLUE BOOK LIST. Leo offers hundreds of bargains on reconditioned gear. Viking II $97.70; NC300 $189.00; Collins 62S-1 $625.50; King 500A $259.00; SP600 $296.65; Heath MRl $59.46; DX-40 $40.50; Cheyenne $49.18; SX-140 $72.15; SX-101 $160.65; HQ14OXA $134.10. Many more. Also, free 1965 catalog. WØGFQ, WRL, Box 919, Council Bluffs, Iowa.

RCA VTVM WV77E $20. Simpson #215 VOM $12. RCA audio generator 30-15000 cy. $15. ART-13 $25. FOB W6IIA, Jack Tate, 425 Tufts Avenue, Burbank, California. 91504.

HT-44 and matching PS-120/150. Like new. Original cartons, manual. 200 watts SSB, CW AM. Asking $375. Gray W2EUQ, Painted Post, N. Y.

HEATH HX-10 transmitter, $250. Hammarlund HQ145C receiver $175. J. Deithloff, 401 Lake Street, Bryan, Texas.

DRAKE 2B-AQ speaker like new, $205. BC-453 Q5'er, New $18.95. New transmitters BC458A, $8.95. BC459A, $12.95. New 829B's $7.95. FOB W9KAJ, Box 55A, Rt. 2, Delavan, Wisc.

CLEANING SHACK. Low and medium power VHF transistors (other types also) at low prices. Send for list. Jack Pritchard, 4336 Livingston, Dallas, Texas, 75205.

GONSET COMMUNICATOR 111 6 METERS. Will sell for $140.00 or trade for 2 mtr. gear. Will ship. K9YCA 64357 Pine Road, North Liberty, Indiana 46554.

CASH, SONY TRANSISTOR TV's etc., swapped for G-R, H-P, L&N etc. laboratory equipment, special tubes, manuals, military electronics. ENGINEERING ASSOCIATES, 438 Patterson Road, Dayton, Ohio 45419.

COLLINS KWM-2, 516EL & PM-2 Power Supplies, Mosley automatic 5 band mobile antenna TM-5, portable Tote-Tenna & case. New cost $1,847. Will sell for $1,200. All in excellent condition. Call Manchester, N. H. evening 472-3641 or address W1ACC P. O. Box 808, 1217 Elm St., Manchester, N. H.

NCX-3 with NCX-A, used only few months, perfect condition, $300. Heath Sixer and Twoer, 4 xtals with each, both $65. New B&K Dynamatic 375 VTVM, warranty card, cost $90, sell $55. All with original accessories and manuals. W3PQK, 615 Market St., South Williamsport, Pa. 17707.

PRECISION COAXIAL TERMINATIONS—Extremely low VSWR from d-c to 1300 mc. Many uses. Send for brochure PTC-1. Radiation Devices Company, P. O. Box 8450, Baltimore, Md. 21234.

SCHEMATICS—of transistorized receivers, transmitters, converters, etc. Send 10c and self addressed stamped envelope for list to: COMMUNICATION INSTRUMENTS CO., Box 466, Yorba Linda, Calif.

MODEL 28 KSR TELETYPE—Mint Condition. John R. Niehaus, 208½ Church Street, Doylestown, Ohio 44230.

SIXTH ANNUAL GREENVILLE HAMFEST will be held Sunday May 2, 1965, at the Greenville County Fairgrounds, Greenville, S. C. Complete program for the family. Plenty of shelter space in case of bad weather. Lunch included in admission price. Information from Don Robertson, WA4KLT, 101 Grin Drive, Greenville, S. C. Sponsored by the Blue Ridge Radio Society.

TOROIDS, uncased, removed from space age surplus. 1.0 Hy .83 Hy .25 Hy 50c ea. Lock City Electronics R.1, Sault Ste Marie, Michigan.

WANTED, all types, Military, Commercial, Airborne, Ground, Electronics Items-Testsets, GRC, PRC, COLLINS, Bendix, Others—We pay Freight. RITCO Box 156, Annandale, Virginia.

UNITS 6, 8, 9, 10, 11A, 11B, SRT14 Synthesizer, New Less tubes. Schematic Unit 6 only—$8.00 ea. 3 for $20.00. RITCO Box 156, Annandale, Virginia. Z-201 First I.F. Amplifier for R423/ARW56 by Collins—39.5 to 98.5 MC. 1 MC Steps Input 24.9 MC output—NEW with tubes $4.00. RITCO Box 156, Annandale, Virginia.

TELETYPE (TYPEWRITER) RIBBONS—Black, New-boxed, all models except 28, also many typewriters, 75 ea—5 for $3.00—Dozen $5.00—Postpaid. RITCO Box 156, Annandale, Virginia.

DRAKE 2B, 2BQ, xtal Cal., Mint cond., $200.00, shipping extra, also HX 11, CW xmtr $35.00. Omer Robbins, 13205 Byers Rd., Grandview, Mo.

HA-6 HALLICRAFTERS SSB/AM/CW TRANSVERTER, HA-2 Converted to 220 mc, both with added voltage regulation for improved stability, AMECO Nuvistor preamps added under chassis, premium quality, first $150 each. Power Supply P-26 $45, manuals. SSB rig HB 80-10 Meters $50; unusual VHF/UHF 50 thru 4000 mc and other gear including 100 Watt Varactors, stamp for list W4API, Box 4095, Arlington, Virginia 22204.

SIX METER COMMUNICATOR III, Good, $125. DX-40, built-in antenna relay, $30. DSB-100 (Sideband) converted to six meters, $35. KØMVR, 424 Twentieth Street N.E., Cedar Rapids, Iowa.

SONAR 20M SSB/CW transceiver with matching AC pwr supply. 200w PEP & full 20m coverage. In good cond. $180. S. Weinrich WA2QKC, 1407 Linden Blvd., Brooklyn 12, N. Y.

RANGER ONE $75. Ranger Two $175. Bill Witsman, K9TMA 23W511 Bryn Mawr Ave., Roselle, Illinois.

ANTENNAS! Mosley TA-33, $45.00; Hy-gain 12AVS, roof mount, extra traps, $18.00; Saturn Six halo with bumper mount, $10.00; Albert Johnson K1IIK, Pinnacle Road, Newport, N. H.

THE BEST WAY TO BUY SURPLUS:

Ask for what you need. We will then send you COMPREHENSIVE DATA on what we have to meet your needs. DON'T ask for a catalog . . . it would take a fat book . . . and then it would give you less details about the thing you are interested in than we will give you in answer to your letter. Be as specific as possible as to frequency, power needed, etc.

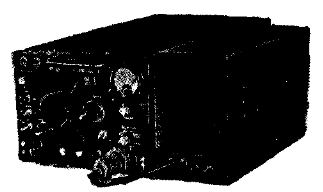
For example, we have THIRTY DIFFERENT MODELS of calibrated-output laboratory-grade Signal Generators ranging from 10 kc to 21,000 mc, and some with power outputs over 10 watts for R.F.I. work, etc. Some FM, some PM, some CW and/or AM.

We have Meters, VTVM's, Bridges, Galvos, Voltage Dividers DC and AC, Digital Voltmeters DC and AC, Counters, Pulse Generators and Delay Systems, other Frequency Meters than those mentioned above, wide variety of Regulated Power Supplies, Line Voltage Regulators from ½ to 10 KVA, Tektronix and other Oscilloscopes, scope Cameras, many types of Graphic Recorders, Spectrum Analyzers, Teletype, Tuning-Fork-controlled Oscillators, Direction Finders, FM Ground Station, Tube Testers, Noise & Field Strength Meters, Ultrasonic generators and test gear, Aeronautical Radio Test Gear, etc. etc. and etc. . . . and we KEEP BUYING NEW MATERIAL ALL THE TIME! Just got in some laboratory Calorimeters, a few Magnetometers, a high-vacuum pump, and even a shipboard Rangefinder and two complete Submarine Periscopes! Much material is here today and gone tomorrow, but we keep a lists of WANTS and will notify you if the item you need gets acquired.

We DON'T sell mdse the way we get it in just to be able to advertise at a price lower than someone else's. We work it over . . . test it . . . overhaul and calibrate it . . . and GUARANTEE SATISFACTION OR MONEY REFUNDED!

WE ALSO BUY so if you have anything to sell, tell us about it and how much you want for it. When we answer your inquiries and describe material we are offering, we also price it. . . . You wouldn't think very much of us if we asked you to make us an offer!

BROADCAST-BAND COMMAND RECEIVER: ARC Type 12, No. R-22. Late type! 540-1600 kc, 6 tubes: RF, converter, 2 IF's & AVC, det. & Noise Limiter, & AF. 2 uv sensit. Needs external pwr sply & control ckts & has no tuning dial. With spline tuning knob, chart to tune exact freq. by turns count, lots of tech data, OK grtd. 9 lbs. FOB Los Angeles **17.95**
(Add $3 for extra-clean selected unit.)



ALL-BAND SSB RCVR BARGAIN: Hallicrafters R-45/ARR-7. 550 kc to 43 mc continuous: Voice, CW. MCW: 2 RF's. 2 IF's: S-meter: 455 kc Xtl. 6 select. choices. Ready to use. w/60 cy pwr sply & book. aligned. fob Los Angeles **199.50**

Deduct $30 if you make your own pwr sply from schematic we furnish. Deduct $20 if SSB not required, or deduct $15 if you will wire in your own SSB with kit & diagram we furnish.

TIME PAY PLAN: Any purchase totaling $160.00 or more, down payment only **10%**

ARC-5 Q-5'er Rcvr 190-550 kc w/85 kc IF's. Use as 2nd converter for above or other rcvrs. Checked electrically. w/lots of tech. data. w/spline knob. 9 lbs. fob Los Angeles **14.95**
(Add $3 for extra-clean selected unit.)

AC PWR for SCR-522: RA-62-B made by Signal Corps for the specific job! 115/230v, 40 60 cy in. Regul. & filt. outputs 300v, .26A; 13v, 4A; -150v. 10 ma. OK grtd, w/data, 90 lbs. fob Sacramento **29.95**

AN/APR-4 RECEIVING UNIT w/tuning units to tune 38-1000 mc plug & handbook. all checked & grtd 100% OK. ready to use on 60 cy fob Los Angeles **179.50**

Add $30 for am/fm version modified for 60 cy pwr input: add $60 for TN-19, 975-2200 mc; add $125 for TN-54, 2175-4000 mc. All uncond. grtd. OK.

LM FREQ METER 125 kc to 20 mc is combin. heter. freq. meter & signal source. CW or AM, accuracy .01%. xtl calib. Clean, checked 100% grtd. w/plug, data. 16 lbs fob Los Angeles **57.50**

Add $10 for EAO, converts for LM Power Supply w/parts, data. included 47 lbs fob San Diego

TS-323/UR, 20-480 mc. Crystal. 001%. W/handbook supplement giving supplementary xtl check points & instruc. to closely approach crystal accuracy. W/schematic, instruct., pwr sply data, clean, checked. 100% grtd. fob Los Angeles **199.50**

R. E. GOODHEART CO., INC.

Box 1220-GC BEVERLY HILLS, CALIF. 90213

Phones: Area 213, office 272-5707, messages 275-5342.

SWAN 350, two months old, including A.C. supply and new VOX accessory $490; Heathkit Twoer $40; Twoer D.C. supply $15; Webster Top Sider mobile antenna $11 75 meter coil $4; 40 meter coil $4; 20 meter coil $3 $550 takes all or will trade for perfect Heathkit SB-300 and SB-400. All equipment barely used, absolutely perfect in original cartons. FOB Bill Siefkin WB6KEH, 603 Johnson #4, San Luis Obispo, California; 805-543-9890 evenings, weekends.

ART-13's Several unmodified ART-13's without the 813 and 811's for sale. Only $16 each. Sorry I can't ship Write first to: Bob Fairfield, WA6EOB, 1782 Industria Way, Los Angeles, California, 90023.

MINIATURE 10K surplus plate relays, DPDT with sockets. Have 50 only. $1.50 each postpaid. R. G. Crouse W7GJS, 2724 West Peninsula, Moses Lake, Washington.

CLEGG INTERCEPTOR VHF receiver in mint condition. $200 firm FOB New Jersey. Glenn C. Ward WA2KZF, RFD 1, Stanhope, N. J.

COLLINS S LINE: 75S3, 32S1, 516F-2, 30L1. Extra clean gear, will trade for 63 or 64 automobile or station wagon. Transtenna 102A, $$3$8. WA4LXX. 251 Collier Avenue, Nashville, Tenn. 37211.

COME TO THE BIG 73 HAMFEST. Sunday, July 4th Peterborough, N. H. Fun for everyone. See page 101.

KILOWATT SSB station with complete antenna system. Station includes Heath SB-300, SB-400, SB-200, HM-11, HO-13, Astatic D-104C. Write for details. W9FMW, 1567 Southfield Road, Evansville, Indiana.

GONSET COMMUNICATOR III-6, microphone, cords, book, $155.00. Heath Sixer with 12v supply, $35.00. Both excellent. Dan Rogers, 3012 Battersea Lane, Alexandria, Virginia 22309.

CLEGG ZEUS & INTERCEPTOR $500 for pair. Worth more than that just to admire. Perfect condition. G. McDowell W7UB, 2455 SW Montgomery Dr., Portland, Ore.

SELLING OUT!!—DX-40 xmtr with Eico 730 modulator and VF-1 vfo, $100. NC-270 rcvr, $165. All mint condx with manuals. Raymond Secrest, Box 102, Pleasant City, Ohio.

Walt, Baby, these DX contests sure are playing hell with our togetherness.

SUBSCRIBE TO 73

In addition to considerable discussion on the new FCC proposals, we'll have a big June surplus issue next month and a giant VHF issue in July. Of course you can follow the "party line" in brand X, if you want . . . but we'll have the real stuff here.

Name ______________________ Call ________

Address ______________________________

City _________________________________

State ______________ Zip Code __________

73 Subscriptions:

1 year $4 __________ 2 years $7 __________

3 years $10 ________ New subscription ________

Renewal ________ Extension of sub __________

IoAR for one year $5 ______________________

IoAR for one year and 73 for one year $7 ______

INDEX TO ADVERTISERS

Propagation Chart

May 1965

J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7*	7	7	7	7	14	14	14	14	14
ARGENTINA	14	14	14	7*	7	7	14	14	14*	21	21*	21*
AUSTRALIA	14	14	14	7#	7#	7	7	7	7	7#	14	14
CANAL ZONE	21	14	7	7	7	7	14	14	14	14	14	21
ENGLAND	14	7	7	7	7	14	14	14	14	14	14	14
HAWAII	14	14	14	7	7	7	7	7#	14	14	14	14
INDIA	7	7#	7#	7#	7#	7#	14	14	14	14	14	7*
JAPAN	14	14	7#	14	7	7#	7#	7*	7	7#	14	14
MEXICO	14	14	7*	7	7	7	14	14	14	14	14	14
PHILIPPINES	14	14	7#	7#	7#	7#	7*	14	14	14	14	14
PUERTO RICO	14	7*	7	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	7#	7	7	7#	7#	14	14	14	14	14	14	7#
U. S. S. R.	7	7	7	7	7	7*	14	14	14	14	14	7*
WEST COAST	14	14	14	7	7	7	7	14	14	14	14	14

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	7	7	7*	14	14	14	14
ARGENTINA	14	14	14	7*	7	7	14	14	14	14	21*	21*
AUSTRALIA	14	14	14	7#	7	7	7	7	7	7*	14	14
CANAL ZONE	21	14	7*	7	7	7	14	14	14	14	14*	21
ENGLAND	14	7	7	7	7	7	14	14	14	14	14	14
HAWAII	14	14	14	7	7	7	7	7*	14	14	14	14
INDIA	14	14	7#	7#	7#	7#	7#	14	14	14	14	14
JAPAN	14	14	14	7#	7	7#	7#	7*	7	7#	14	14
MEXICO	14	14	7	7	7	7	7	7*	14	14	14	14
PHILIPPINES	14	14	14	7#	7#	7#	7#	7*	14	14	14	14
PUERTO RICO	14	14	7*	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	7#	7	7	7#	7#	14	14	14	14	14	14	7#
U. S. S. R.	7	7	7	7	7	7	7*	14	14	14	14	7*

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	14	7	7	7	7	7*	14	14	14
ARGENTINA	14	14	14	14	7	7	7#	14	14	14	21*	21*
AUSTRALIA	21	21*	21	14	14	14	7	7	7	7	14	21
CANAL ZONE	21	14	14	7*	7	7	7*	14	14	14	14*	21
ENGLAND	14	7	7	7	7	7	7	7*	14	14	14	14
HAWAII	21	21*	21	14	14	7	7	7	14	14	14	14
INDIA	14	14	14	14	7#	7#	7#	7#	14	14	14	14
JAPAN	14	14	14	14	7#	7	7	7	7	7#	14	14
MEXICO	14	14	7*	7	7	7	7	7	7*	14	14	14
PHILIPPINES	14	14	14	14	14	7#	7	7#	14	14	14	14
PUERTO RICO	14	14	14	7	7	7	7*	14	14	14	14	14
SOUTH AFRICA	7#	7#	7	7#	7#	7#	7#	14	14	14	14	7#
U. S. S. R.	7	7	7	7	7	7	7	7*	14	14	14	7*
EAST COAST	14	14	14	7	7	7	7	14	14	14	14	14

Very difficult circuit this hour.
* Next higher frequency may be useful this hour

Good: 1-9, 12-14, 20-22, 26-29
Fair: 11, 17-18, 23-25
Poor: 10, 15, 16, 19, 30-31
VHF DX: 7, 8, 18, 19, 26

The

INSTITUTE

OF

AMATEUR

RADIO

Dear IoAR Member

Enclosed you will find the proposed Constitution and By-Laws for the Institute. I've prepared them separately so you can file them away. If you have any proposed changes to make please send them in the form indicated. We will then send you a copy of the modifications proposed for your consideration and vote.

The matter of officers of the Institute is left up to the Directors under these By-Laws, the idea being not to be tied down as to officers until the Institute has grown a bit and the needs of the Institute dictate the election of officers. The present system puts the Institute directly in the hands of the Directors, who are elected by all of the members. The Directors then can select any officers they need for the functioning of the Institute. Right now this officership consists of one unpaid Secretary.

The Institute is continuing this year the informational mailings to Congress. Under preparation at present is a booklet explaining the difference between Citizens' Band and Amateur Radio. This is particularly important right now when all Congressmen are being flooded with mail from angry CB'ers who want hobby-type operation continued on the CB channels.

The future of Amateur Radio is closely linked with our Congress. Remember that the FCC is an agency set up and controlled by Congress. It is therefore of vital importance for Amateur Radio to be in good communications with Congress...to have the Congressmen understand Amateur Radio and appreciate it.

As you know, only the Institute of Amateur Radio is registered to lobby for Amateur Radio and no other organization is, under severe penalties, permitted to do so. This means that the ARRL is prohibited by law from representing Amateur Radio unless they make

CONSTITUTION AND BY-LAWS
OF
THE INSTITUTE OF AMATEUR RADIO

ARTICLE I
PURPOSE OF THE INSTITUTE

Section 1. THE INSTITUTE OF AMATEUR RADIO is a non-profit corporation organized and existing under the laws of the State of New Hampshire, pursuant to provisions of Chapter 292, R. S. A., having been duly qualified as a corporation on the 28th day of August, 1963.

Section 2. The purpose for which the Institute is founded is to promote national and international friendship and to enhance the technical state of the art of amateur radio.

Section 3. The Institute is entitled to enjoy all the rights and privileges granted to non-profit corporations under the laws of the State of New Hampshire.

Section 4. The Institute, as a non-profit corporation, is entitled to acquire money, funds, and property, and to deal with the same in the best interests of the Institute and in the best interests of amateur radio. In the event of dissolution of the Institute, then in that event, none of the money, assets, or property of the Institute shall be distributed to any individual member, person or persons, but the same shall be conveyed in trust to a corporate trustee duly qualified to conduct a trust business within the State of New Hampshire, the said property to be used be said trustee in the furtherance of the aims and purposes of the Institute, or else donated to a non-profit humanitarian organization.

Dear Institute Member,

Here are the proposed Constitution and By-Laws of the Institute. These have been worked and reworked by the Directors and are still not all we could hope for. But they do represent a good foundation for the Institute to build on and seem to answer most of the pressing problems immediately facing the Institute.

Please read the by-laws over carefully and make notes on any sections that you think can be improved. Then, rather than writing in saying that you don't agree with article such and such, send in your proposed article which will supplant it. In this way we can make all proposed improvements available as votable alternates to all members without any question of editing or changing by me. All changes and additions submitted during the next two weeks will be considered. Informal suggestions will not be considered.

The next step will be to submit all proposed changes to you for a vote. The result of this vote will be our finished by-laws. These by-laws will be sent to you and will be published in 73.

With or without accepted by-laws the work of the Institute has been going on. Rather than spend our few funds on continuous communications with the membership we have been allocating them to our work in Washington, where we will do the most long range good.

73

Wayne

ARTICLE II
DIRECTORS

Section 1. The Institute shall have five Directors whose term of office shall be for three years, except that two of the first five Directors shall hold office for a term of two years, and one shall hold office for a term of one year only. Thereafter, all Directors shall hold office for three years.

Section 2. The Directors shall exercise all authority and shall be in active management and control during the term of their office of all the business of the Institute, and all power with reference to the management and control of the said Institute shall vest in said Directors subject only to the laws of the State of New Hampshire. The Directors shall have the power to create an executive committee, all of the voting members of which shall be members of the Board of Directors, and which committee shall consist of not less than three members, but said executive committee shall in no event have the power to make policy decisions and shall be restricted in its powers to the carrying on of the day to day business of the Institute between meetings of the Board of Directors.

Section 3. In the event of the resignation, death, disability, or removal of any Director prior to the expiration of his elected term of office, such vacancy shall be filled by the remaining members of the Board of Directors until the next regular election.

Section 4. No person shall be eligible to hold office as a Director of the Institute unless he shall have been a member in good standing of the Institute for a period of not less than six months prior to the date of his election, and held a valid amateur radio license for a period of not less than 18 consecutive months prior to the date of his

nomination or election.

Section 5. The Directors shall hold regular meetings at least four times per year, said regular meetings shall be held on the second Monday of each January, April, July, and October.

Section 6. The Directors may hold such additional meetings as frequently in their opinion as the business of the Institute requires the same.

Section 7. Special notice of the holding of the regular meetings of the Board of Directors shall not be required, but no special meetings of the Board of Directors shall be held unless and until each Director shall have been given at least 48 hours actual notice of such meeting.

Section 8. A majority of the authorized number of Directors shall be necessary to constitute a quorum for the transaction of business, except to adjourn a meeting. Every act or decision done or made by a majority of the Directors present at a duly held meeting of the Board at which a quorum is present shall be regarded as the act of the Board of Directors.

Section 9. The Directors shall receive no fees or compensation for their services as Directors, but nothing herein contained shall be deemed as preventing said Directors from being reimbursed for necessary traveling expenses in connection with their attendance at Directors' meetings.

Section 10. The Directors shall be elected by a secret ballot of the members of the Institute.

Section 11. A Director may be removed from office by a majority of all votes cast by members of the Institute.

the necessary disclosures for registering. So far they have not seen fit to make these disclosures. It is entirely possible that this fear of disclosure is tied in with the mysterious tax situation that ARRL enjoys. We understand that the Internal Revenue Service is starting a careful investigation of this situation and it is possible that the League may soon have to dig into that half million that is rumored to have been put aside to bail them out of expected tax liens.

Since a good deal of the problems that beset Amateur Radio today are the direct responsibility of the League it would not be fair to you, as a member, if we were to try to ignore them. After all, if the ARRL were adequately representing Amateur Radio there would be no need for the Institute.

So let's look at the current situation.

The League is faced with more problems than it has ever had before in its existence...and all of them are the direct result of bad management. Probably most important of all for the future of Amateur Radio is the widening split between the ARRL and the European Amateur Radio Societies. The IARU is in a turmoil over the parochial thinking and lack of leadership of ARRL management. It now looks as though IARU region I (Europe and Africa) may make a complete break from ARRL.

Another matter of grave import to ARRL members is the libel suit brought against Huntoon and the League by W2BIB. In his letter of last June to all member clubs, Huntoon printed what looked to me like libelous statements about a ham, identifying him to the extent that there was no question in my mind...or in those of many people whom I talked to about this...about who was meant. And since this fellow has done highly paid work for amateur equipment manufacturers this sort of publicity could and perhaps already has hurt him severely. There is no possible way that the harm Huntoon foolishly

has done can be undone and this could easily cost the League well over a million dollars.

Suppose you were a fellow who had spent a lifetime building up the world-wide contacts to make you worth a hundred thousand a year or more to the companies you represent. You are in your fifties with no possibility of starting over again. Then along comes a magazine editor, irritated with you over a clever deal of his that you exposed, and he libels you. Would you sue for a million? You bet you would.

Now what is Huntoon doing about this? I hear that he has hired the most expensive libel lawyer in the world, Louis Nizer, to try to beat the rap. Nizer's fees usually start at around $25,000. It would have been a lot less expensive to have checked the letter with the ARRL's General Counsel Booth in the first place. Huntoon, like Hoffa, is going to let the members pay for his mistakes, so it means nothing to him. Will the Directors fire him for this million dollar blunder? Will they dock his $20,000 a year salary? Don't count on it.

You can get more details on the libel suit in the K6BX News Letter. It is worth every bit of the 50¢ price tag. Write K6BX, Box 385, Bonita, California and read a 22 page indictment of the League. He quotes letter after letter after letter from ARRL Directors to other Directors and Assistant Directors. You should read this one.

All is not bad by a long shot. I'm encouraged to find that Herb Hoover is making plans to pay for a spectrum study by an independant laboratory out of the $100,000 slush fund voted by the Directors last May. I suggested that this be done in my editorials several times...I'm glad to see that this didn't prevent it. Also, I was afraid that the 100G would get sort of used up on family trips to Europe by League

Continued on page 14

then the Board of Directors at the next regular meeting shall be required to place the matter on their agenda and shall be required to hear from a representative of such petitioning members with reference to their objections or grievances. Said petitioning members shall be notified by the Institute of the date, time, and place of the holding of such a meeting when said petition will be considered. In the event that such a petition be heard by the Board, and the said member or members be still dissatisfied with the action of the Board, then the said petitioning member shall have the right to petition the members for a referendum. In the event that the said petition for such referendum be signed by one hundred members of the Institute, and the said petition be filed with the Institute, then the Board of Directors shall meet within fourteen days after such filing and at such special meeting representatives of the petitioning members shall be entitled to a further hearing. The Directors shall render a full and fair report of such meeting to the membership within fourteen days thereafter.

ARTICLE VI
AMENDMENTS TO THE BY-LAWS AND CONSTITUTION

Section 1. The constitution and these by-laws may be repealed or amended by the members at any time as follows:

(a) Any member or members desiring to amend or repeal any provisions of these by-laws may circulate a petition among the members wherein the changes or amendments sought to be made are set forth, and whenever 25% of the members have signed such a petition to amend the by-laws, the said petition shall be filed with the Institute, who shall thereafter put the proposed changes to a vote of the membership. The by-laws or the constitution may thereupon be amended by a two thirds majority vote of all votes cast by members eligible to vote.

(b) The Directors shall have the authority to propose amendments or modifications to the by-laws and the constitution whenever in their judgement they may consider such change as beneficial to the operation of the Institute. Amendments or modifications of the by-laws proposed by the Directors shall become effective on an ad-interim basis by unanimous vote of all Directors.

ARTICLE VII
FINANCIAL REPORTS

Section 1. The financial condition of the books and records of account of the Institute of Amateur Radio shall be prepared annually by a Certified Public Accountant and a copy of the financial condition of the Institute as well as its current operating statement shall be submitted to all members.

ARTICLE VIII
EFFECTIVE DATE OF THE BY-LAWS AND CONSTITUTION

Section 1. The foregoing shall be designated as the Constitution and By-Laws of the Insitute, and reference thereto may be made either as the Constitution or the By-Laws, said terms being interchangeable as used herein.

Section 2. These By-Laws shall become effective upon adoption by the interim Board of Directors and upon ratification and approval by a two thirds majority vote of all votes cast by members of the Institute.

IoAR STATEMENT 10 MARCH 1965

INCOME

486 members @ $10 - - - - - - -	$4860.00	
115 members @ $ 9 - - - - - - -	1035.00	
17 members @ $ 8 - - - - - - -	136.00	
	6031.00	

EXPENSES

Legal aid for WØJRQ in antenna fight - - - - - - - - - - - - -	$ 500.00
Washington Newsletters (congress) -	250.00
Clipping service for newsletter - -	246.75
Membership supplies (buttons, stickers, cards, etc.) - - - - -	527.00
Stationery and paper supplies - - -	306.23
Postage - - - - - - - - - - - - - - -	189.79
Labor (processing memberships, keeping records, preparing certificates and membership cards, writing and preparing booklets and mailings, making stencils, filing stencils, photography, printing, etc. - - - -	752.00
Phone, electricity, office space - -	00.00
Miscellaneous - - - - - - - - - - -	3.19
	$2774.96

ON HAND - - - - - - - - - - - - - - - $3256.04

employees. Since no public accounting ever seems to be made on funds like this one never knows what is happening.

The Institute Directors had a short meeting in Washington at the year end and decided, in view of the unexpectedly low expenditures for 1964, to lower dues for 1965 to $5 and extend all Founding Members for another year. Since there has been considerable pressure to arrange for some sort of combination Institute membership and 73 subscription it was decided that a special price for the combination would be set at $7. In order to align subscriptions and memberships in the Institute it was decided to accept combinations at $7 and extend the Institute membership to the end of the current 73 subscription plus one year so that both would in the future end simultaneously.

It was decided that the original Charter Members of the Institute would hold their seniority and that any future memberships would be indicated as Charter Memberships, even though there may have been a lapse in membership.

Your Support

The Institute is planning on continuing its series of information booklets to Congress, as mentioned earlier. This will particularly emphasize the benefits of Amateur Radio to the country...and to them. Our approach will be to try to interest them personally in taking up ham radio...explaining why it will be valuable to them in keeping in touch with their constituents and giving them a broader knowledge of our technical world. We'll point out how simple it is to get the first license for Novice operation and what is necessary to progress to the General license. We'll lean heavily on the public service aspects of our hobby and also the international good will and benefits. It is hoped that this approach will get more personal attention that a straight information sheet might.

Institute
of
Amateur
Radio
Membership
Application

Name ______________________ Call ______________________

Address ____

City ______________________ State ________ Zip ________

______ $5 enclosed for one year membership dues.

______ $7 enclosed for one year membership PLUS one year of 73 Magazine. (Please fill out the form below, too.)

______ I am not now a subscriber to 73.

______ I am a subscriber, so please extend my IoAR membership to terminate with my current 73 subscription plus one year. *

* All combination membership and subscriptions will extend the current subscription of 73 for one year and the Institute membership until the end of the 73 subscription so the two will end together. Thus if your present 73 subscription runs until December 1965 (your stencil will say D5) then both your subscription and your IoAR membership would run until December 1966. Naturally we can not extend any memberships in the Institute on the basis of subscriptions sent in to 73 after this offer has been announced.

73
Subscription
Form

Name ______________________ Call ______________________

Address ____

City ______________________ State ________ Zip ________

______ $7 enclosed for 73 subscription and IoAR membership.

______ This is a new subscription to 73.

______ This is an extension of a current sub.

______ This is a renewal of an expired sub.

______ $4 enclosed for a one year subscription to 73 with NO Institute Membership.

______ $7 enclosed for two years of 73, with NO Institute membership.

The INSTITUTE OF AMATEUR RADIO

BULK RATE
U.S. POSTAGE
P A I D
Peterborough, N.H.
Permit No. 73

PETERBOROUGH, NEW HAMPSHIRE

Joseph C. Strolin, K1REC
21 Ellen St.
Norwalk, Conn.

All this work costs money, obviously. We are doing it all at an absolute minimum cost with no paid employees of the Institute so far and taking full advantage of the sizeable investment in printing and production facilities and personnel at 73 magazine. Sure, we could have mailed you a bulletin every month telling you what was going on, but this would have taken funds from our work on Congress and that is our main reason for existence. Bear with us.

Support of the Institute will, more than any other way, bring you results in keeping ham radio alive. 100% of the money of the Institute is devoted to Institute pursuits as compared with about 10% of the money received by the ARRL being spent on League matters, with about 90% being spent on their giant publishing business. You get $5 worth of representation with the Institute for your $5 investment and about 50¢ worth of contests, QSL's, and activities from your $5 to ARRL. It comes down to investing in your fun here and now or investing in the future.

Said Nominating Petition shall be filed with the Institute not less than sixty days prior to the date of the election of Directors. Immediately upon the filing of such a petition the Secretary of the Institute shall verify the eligibility of the person so nominated, and if said person is found to be eligible, then his name shall be placed upon the ballot.

Section 5. All elections shall be by secret written ballot.

ARTICLE IV
RECORDS, REPORTS AND INSPECTIONS

Section 1. The Institute shall maintain adequate and correct accounts, books, and records of its business, properties, and affairs. All such books, records and accounts shall be kept at its principal place of business within the State of New Hampshire, said place of business to be fixed by the Board of Directors.

Section 2. All books and records provided for in these by-laws or which may be required by the laws of the State of New Hampshire, shall be open for the inspection of the Directors and any member at any time during regular and usual business hours. The Board of Directors shall render to the members a full and fair report of the affairs of the Institute within thirty days after each regular meeting of the Board.

ARTICLE V
MEMBERSHIP REFERENDUM

Section 1. In the event that any member or members should feel aggrieved by any act or decision of the Board of Directors, said member or members shall have the right to petition the Board of Directors for redress or corrective action. Said petition for redress or corrective action shall be signed by a minimum of ten members. In the event that such a petition be filed with the Institute,

ARTICLE III
MEMBERSHIP

Section 1. There shall be one class of membership only in the Institute.

Section 2. Membership dues or fees shall be fixed by the Board of Directors.

Section 3. The members shall have the right to nominate and elect the Board of Directors.

Section 4. Nomination for Directors shall originate with the membership. Any member or members desiring to place in nomination any person as Director shall sign and file with the Institute a nominating petition, which shall read in substance as follows:

> The undersigned hereby nominates ______________________ to serve as a Director of the Institute of Amateur Radio. The undersigned requests that the Secretary certify his eligibility and place his name on the ballot.
>
> Dated: ___/___/___
>
> ______________________
>
> ______________________
>
> ______________________
>
> This nomination meets with my approval:
>
> ______________________
>
> nominee

Said Nominating Petition shall be signed by a minimum of three members, and the nominee.

73

JUNE 1965
Brand new, unused 40c

Amateur Radio

SURPLUS CATALOG

A MOST COMPREHENSIVE ISSUE

SURPLUS CONVERSIONS

AND AN

OBJECTIVE DISCUSSION OF ARRL'S IDIOTIC DOCKET 15928

73

Magazine

Wayne Green W2NSD/1
Editor & Publisher

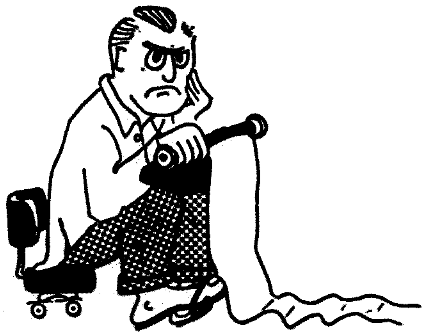
Paul Franson WA1CCH
Assistant Editor

June, 1965

Vol. XXXII, No. 1

73 Magazine is published monthly (thank heavens it's not weekly) by 73, Inc., Peterborough, N. H. Zip 03458 (terrible number). The phone is 603-924-3873. Subscription rates $4.00 per year, $7.00 two years, $10 three years world wide. Second class postage is paid at Peterborough, New Hampshire and at additional mailing offices. Printed in New Hampshire, U.S.A.

Postmasters, please send form 3579 to Good Old 73 Magazine, Peterborough, New Hampshire. You are coming up for our July 4th hamfest, aren't you?



de W2NSD/1

never say die

Docket 15928 . . . Incentive Licensing?

Let's save the fury and hysteria for later . . . first let's take a close look at the proposals. I don't know about you, but I have gone through a nasty time with this one . . . indignation, frustration, apathy. Grab the panic handle and read on.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D. C. 20554

In the Matter of
Amendment of the Amateur Radio
Service Rules to provide for
Incentive licensing and
Distinctive Call Signs

DOCKET NO. 15928
RM-378, 455, 470, 474
480, 481, 499, 516,
517, 538, 577

NOTICE OF PROPOSED RULE MAKING

By the Commission: Commissioner Loevinger absent.

1. The Commission has under consideration nine petitions proposing, to varying degrees, that special privileges be given to the holders of Amateur Extra Class licenses as an incentive for licensees to obtain this highest class of Amateur operator authorization. Many of the petitioners additionally propose that, as a stepping-stone to the Amateur Extra license, another higher class of operator license be created which would also carry special privileges as an inducement to its attainment. A number of the petitioners recommend changes in the procedure for assignment of station call signs to correspond to a new license structure.

Since we shall consider the call sign problem in this connection, we will also consider RM-470 and RM-474, petitions which are solely concerned with the call sign assignment procedures. The attached appendix lists the petitioners.

2. To support their proposals, the petitioners essentially contend that there is a need for a general improvement and "up-grading" of operations in the Amateur Radio Service which can best be fulfilled by establishing an "incentive licensing" program. They maintain that amateur operators will thereby be encouraged to self-improvement by qualifying for higher classes of licenses. The chief proponent of these views is the American Radio Relay League (ARRL), a national Amateur radio organization with approximately 85,000 members. In its petition, RM-499, the ARRL states:

"A most significant trend has developed in the last few years which has caused increasing concern to the League as to whether the basic purposes and objectives of the amateur radio service, particularly those relating to technical qualifications and proficiency, as set forth in subparagraphs (b), (c) and (d) of Section 12.0 [97.1] are being and may continue to be adequately achieved.

This trend has arisen from two developments, . . .

In 1951, the Commission after an extensive rule making proceeding in Docket No. 9295, adopted major changes in the amateur license structure. Both lower-level (Novice and Technician) and higher-level (Amateur Extra) classes were established with commensurate examination requirements. All frequency bands and all modes of operation were made available equally to the Amateur Extra, Advanced, General and Conditional Class. Although special privileges were contemplated by the Commission for the new Amateur Extra Class, none has yet been adopted. Thus, once an amateur has obtained his General or Conditional Class license he no longer has any practical or meaningful incentive to increase his technical knowledge and proficiency and earn a higher grade of license.

The second development contributing to the trend is the development and availability of highly complex and efficient manufactured equipment, particularly single sideband suppressed carrier (SSB) radiotelephone transmitters, receivers and transceivers. The design and construction of many equipments are so excellent and the operation is so simple that it no longer is necessary for an amateur using such equipment to have practical knowledge sufficient to construct his own equipment or to even fully understand the circuitry and theory of operation of the manufactured equipment. As a result, there has been little incentive for many amateurs, once licensed, to increase their technical knowledge and proficiency as contemplated by subsections (b), (c) and (d) of Section 12.0 [97.1] of the Commission's Rules."

3. A summary of the specific pertinent proposals in the petitions under consideration is as follows:

a. Six petitions (RM-455, 480, 499, 516, 517, 538) propose that the Advanced Class license, which has not been issued to new applicants since 1952, be again made available but as a new higher clas of authorization with special privileges. Some of the petitioners would "grandfather-in" the present holders of the old Advanced Class license (about 40,000). While the suggestions vary as to the type of examination which would be required for this new Advanced Class license, they generally contemplate a difficulty level somewhere between that of the examinations for the General and Amateur Extra Class licenses.

b. RM-577 advocates that there be both an "Extra Phone" and "Extra CW" license, both licenses to be issued to present holders of the Amateur Extra Class license. Other persons could then apply for either or both licenses, depending upon the type of operation desired.

c. With regard to the nature of the privileges for these higher classes of licenses, six petitions (RM-455, 480, 481, 499, 516, 517) propose the reservation of portions of high frequency (HF) telephone bands between 3.5 and 29.7 Mc/s. RM-455 would additionally reserve HF telegraphy segments for the Amateur Extra Class. RM-538 and 577 recommend reserved telephony and telegraphy sub-bands in all, or most, of the bands below 148 Mc/s for the Amateur Extra Class. Three petitions (RM-455, 499 and 516) would leave the width of the present HF telephony sub-bands unchanged but available only to Advanced and Extra-Class operators while three others (RM-481, 517, 577) would expand the width of the telephony bands but reserve only portions thereof to the Advanced and Extra Class. Two petitions (RM-481 and RM-577) recommend that the reserved telephony segments be restricted to single side band or suppressed carrier emissions. RM-499 and RM-516 propose a staggered timetable for implementation of the resevation of the telephony bands.

d. RM-378 proposes that two-letter station call signs (call signs with a single letter prefix and a double letter suffix) be issued to holders of the Amateur Extra Class license. A number of the other petitions also recommend new call sign assignment procedures which relate to the 'incentive licensing" program.

4. The proposals for an 'incentive licensing" program have generated the largest number of comments and the greatest controversy in an amateur rule-making matter in many years. Nearly all of these comments are in response to RM-499, the ARRL petition. A large number of persons, about equally divided, merely approved or opposed RM-499. Of those who gave reasons for their opposition, only a very few aparently felt that an 'incentive licensing" program was not desirable or was unnecessary. These persons either thought that amateur radio operations were presently satisfactory or that methods other than "incentive licensing," such as requiring an examination for license renewal, would cure any ills. Many objectors tc the ARRL proposal stated that the reservation of frequency bands to higher class licensees to the extent advocated by the League would unduly encroach upon the operating privileges of the lower classes of licensees. They maintained that loss of these most desirable frequency bands would force licensees to acquire higher classes of licenses in order either to utilize their equipment or to enoy the most rewarding aspects of amateur radio operation.

Endorsement of the ARRL position was received from many persons of widely diversified interest in the Amateur Radio Service.

a. From a retired former Chief Signal Officer of the Army:

"During the early years of my military career (the 1930's) whenever an individual who possessed a radio amateur license came to my attention I did my utmost to have the individual assigned to communications work. His license spoke well of his technical understanding and intense interest. During the latter part of my career (the last decade or so) such has not been my feeling. The license has generally meant 'Here is another hobbyist—maybe he has it and maybe he doesn't.' The license has lost its stature; it appears to be anybody's, just for the asking . . ."

b. From the Bar Association Librarian of a large city:

"It does not disturb me that for a time I may be precluded from operating in certain bands until I have demonstrated that I am able to understand and therefore successfully negotiate more advanced requirements. May I say here that I do not believe the reliability of commercially produced equipment to be any excuse for ignorance in its operators.

I see every reason to believe that the amateur service would flourish under an incentive program. In this era of continuously pressed demands for increased competence in every area of activity, I cannot see how amateur radio can prosper if it adheres to the comfortable ways of yesterday."

c. From the president of a leading electronics manufacturing company:

"A decade ago when a licensed radio amateur applied to the company for employment, mere possession of a 'ham ticket' was sufficient guarantee that the holder was technically competent, could read a schematic, had the capability to learn, and was capable of mature growth in the industry. Many of today's leaders in the electronics field advanced along this very path. Now, although the electronics industry is in chronic shortage of trained technicians and engineers, by and large, applicants for these jobs are not coming from the ranks of the radio amateur. Possession of a radio amateur license does not now mean that the holder is technically qualified in any sense. On the contrary, the Personnel Department of this Company has been continually disappointed with the quality, calibre and technical ability of holders of radio amateur licenses to such an extent that such individuals are subject to careful screening before they are considered for employment."

d. From a college engineering and technology educator:

"As a college instructor, we automatically assumed (and with good basis) that an engineering student who was also a radio amateur, would be a highly capable student willing and able to accept the loads and responsibilities of an engineering program. This idea to an even higher degree was present when the new student possessed a license of one of the more advanced classes . . .

In contrast, today we in education almost prefer not to have our students come to us with amateur radio licenses. Typically, today's ham is concerned with contests and chatter and knows little or nothing of theory and construction. His approach to study and lab is hit-or-miss or the try-this-or-that approach. He appears never to have tried to understand the basis of electronics to say nothing of his equipment itself. He has probably never wired anything more complex than a cable or two and would not consider the modification or service of even his personal receiver. He simply wouldn't know how and is not really interested in it beyond its function of reception."

e. From the Communications director of a state Civil Defense department:

"The . . . Division of Civil Defense values very highly the service rendered to our organization by amateur radio operators through the Radio Amateur Civil Emergency Service. Without this Service our emergency communications would be severely handicapped. The reservoir of trained technicians, available within the amateur radio service, is of immeasurable value to the success of our civil defense program in (the State).

With this thought in mind, it is felt that any attempt to up-grade the amateur service will ultimately result in a higher grade of trained personnel which may be called upon in time of national emergency. . . Therefore I would like to recommend immediate adoption of the suggestions contained in their proposal, and further recommend a complete revision of the examination material with the view of increasing the scope of the examination as well as the degree of difficulty of the questions contained therein."

5. The Commission has carefully considered each of the subject petitions and the documents in response thereto in the light of its responsibilities under the Communication Act to regulate the use of the radio frequency spectrum in the public interest, convenience, and necessity. It i altogether clear that justification for the continued allo cation to the Amateur Radio Service of a substantial por tion of the spectrum in the face of incessant and im portant demands by other radio services can not b founded on anything other than a continuing movemen of the Amateur Service toward the goals specified i Section 97.1 * of the Amateur Rules. It is the Con

* "§97.1 Basis and purpose. The rules and regulations i this part are designed to provide an amateur radio servic having a fundamental purpose as expressed in the followin principles: (a) Recognition and *enhancement* of the valu of the amateur service to the public as a voluntary no commercial communications service, particularly with r spect to providing emergency communications. (b) Co tinuation and *extension* of the amateur's proven ability contribute to the advancement of the radio art. (c) E couragement and *improvement* of the amateur radio servi

mission's opinion that revision of the present license operating privilege structure is an appropriate and desirable step to take at this time to insure such progress and place a proper emphasis upon the quality of the service as well as upon its mere numerical growth and activity. Accordingly, we propose to revise our rules to provide for higher classes of licenses with special privileges as an incentive to the general "up-grading" of licensees. We propose, additionally, to revise the privileges and term of the Novice Class license, to modify a basis of eligibility for the Conditional Class license, and to provide for distinctive station call signs. These latter proposals are all considered to be consistent with, and necessary to, an incentive licensing program.

It has been suggested in some of the comments that, although there is a need for improvement of licensee knowledge and proficiency in the Amateur Radio Service, rule changes are not appropriate since the licensees should adopt their own program for improvement. While, of course, self-initiative by licensees is vital, we can not agree that Commission action is inappropriate. Section 97.1(c) of the rules clearly contemplates the improvement of the Amateur Radio Service through rules which provide for the advancement of skills in both the communication and technical phases of the radio art.

6. In consideration of the foregoing, the Commission proposes amendment of its Amateur Radio Service Rules as follows:

A—A new higher class of license to be designated the Amateur First Class license shall be created. Eligibility for this license shall be limited to an Advanced, General or Conditional Class licensee who has held such license for at least one year. Examinations for this license will be conducted at Commission Field Offices or examination points. Applicants will be required to pass a 16 word per minute code test and a written examination of a difficulty level between the General and Amateur Extra Class examinations.

B—Holders of either the Amateur Extra Class or the Amateur First Class license shall be exclusively entitled to utilize the frequency segments 3800-3850 kc/s, 7200-7225 kc/s, 14200-14235 kc/s, 21250-21300 kc/s, 50-50.1 Mc/s, and 144-144.5 Mc/s effective one year after adoption of these rule changes, and 3800-3900 kc/s, 7200-7250 kc/s, 14200-14275 kc/s, 21250-21350 kc/s, 50-50.25 Mc/s, and 144-145 Mc/s effective two years after adoption of these rule changes.

C—Holders of the Amateur Extra Class license shall be exclusively entitled to utilize the frequency segments 3500-3525 kc/s, 7000-7025 kc/s, 14000-14025 kc/s, and 21-21.025 Mc/s effective one year after adoption of these rule changes, and, 3500-3550 kc/s, 7000-7050 kc/s, 1400-14050 kc/s, and 21-21.050 Mc/s effective two years after the adoption of these rules changes.

D—The Advanced Class license shall no longer be renewed. Present holders of this license shall be issued the General Class license upon renewal. The basis for this proposal is that there no longer exists any valid distinction between the Advanced and General Class licenses as to the difficulty of the examination. Therefore, continued issuance of the Advanced Class license has become an unnecessary administrative burden and, under an incentive licensing program, would merely lead to confusion.

E—The Conditional Class license shall no longer be available to new applicants who claim eligibility solely by virtue of active duty in the military service. This proposal is consistent with the Commission's policy that, where feasible, applicants for higher classes of amateur licenses be examined by Commission personnel rather than by volunteer mail examiners. Of course, many military members will be able to establish their eligibility for the Conditional Class license under one of the other categories such as the distance basis or temporary overseas residence.

ırough rules which provide for advancing skills in both ;e communication and technical phases of the art. (d) *ɛpansion* of the existing reservoir within the amateur dio service of trained operators, technicians, and elec- ɔnics experts. (e) Continuation and *extension* of the nateur's unique ability to enhance international good will."

F—New holders of the Novice Class license shall be given a two year non-renewable license term in lieu of the present one year non-renewable term. This will afford Novice Class licensees a more reasonable period for the development of skills necessary to advancement to the higher classes of licenses.

G—Effective one year after adoption of these rules, telephony privileges for the Novice Class licensees in the frequency segment 145-147 Mc/s shall be deleted. Deletion of this privilege is proposed because too many Novice Class licensees operate telephony equipment to the neglect of improvement of their telegraphy speed. One of the prime purposes of the Novice Class license is to prepare, through actual operating experience, for the higher classes of licenses which require increased code proficiency.

H—Each new amateur station shall be systematically assigned a distinctive call sign to denote the licensee's class of operator license.

This is necessary in order for our monitoring facilities to immediately determine whether a particular licensee is operating within the range of his privileges and whether a licensee is subject to re-examination of his qualifications.

The following schedule will be used for assignment of station call signs. Presently assigned call signs will be changed upon renewal or modification of the station license to conform with this schedule:

(1) Amateur Extra Class—the single letter prefix "W" and a double letter suffix, provided that the licensee submits evidence of having held an amateur station license issued by the United States Government prior to July 1, 1932 (e.g. W2AB); a double letter prefix beginning with the letter "W" and a double letter suffix (e.g. WA2AB); **

(2) Amateur First Class—the single letter prefix "K" and a double letter suffix, provided that the licensee submits evidence of having held an amateur station license issued by the United States Government prior to July 1, 1932 (e.g. K2AB); a double letter prefix beginning with the letter "K" and a double letter suffix (e.g. KA2AB);

(3) General (Advanced)—a single letter prefix and a three letter suffix (e.g. W2ABC);

(4) Conditional—the double letter prefix "WC" or "WD" and a three letter suffix (e.g. WC2ABC);

(5) Technician—the double letter prefix "WT" or "WU" and a three letter suffix (e.g. WT2ABC);

(6) Novice—the prefix KN and a three letter suffix (e.g. KN2ABC);

(7) The call signs of General (Advanced), Conditional or Technician Class licensees who currently hold a station call sign which has a single letter prefix and a double letter suffix will not be changed solely because of failure to qualify for an Amateur First or Extra Class license.

(8) Stations located in Alaska, Hawaii, Puerto Rico, and in United States possessions under Commission jurisdiction will be assigned special double letter prefixes to show their specific locations followed by a double or triple letter suffix which will, where feasible, indicate the class of operator license.

I—Assignment of station call signs shall be in accordance with the foregoing schedule with only the following exceptions:

(1) A specific unassigned call sign may be reassigned to a previous holder thereof provided that it is appropriate to the class of operator license currently held by the station licensee;

(2) A specific unassigned call sign may be assigned to an amateur organization in memoriam to a deceased member and former holder thereof provided that it is appropriate to the class of operator license currently held by the station trustee;

(3) A specific unassigned call sign may be temporarily assigned to a station connected with an event, or events, of general public interest provided that it is appropriate to the class of operator license currently held by the station trustee or licensee.

7. It is the Commission's belief that these proposed amendments reflect a realistic solution to the need for an immediate and effective incentive licensing program in the Amateur Radio Service as advocated by most of the petitioners. To the extent that the particulars of any of the petitions involved are at variance with these proposals, they should be considered as having been denied. However, this does not preclude, and the Commission hereby encourages, the submission of new counter-suggestions for consideration. Comments are particularly invited as to: (1) the utility and interest in continuing the Amateur Extra Class of license in the light of the proposal to establish an Amateur First Class license and the possibility that the reserved frequencies associated with the Amateur Extra Class may not be fully occupied; (2) the width and the placement of the various reserved frequency segments for each class of license in each band.

8. These proposed amendments are issued pursuant to the authority contained in Section 4(i) and 303 of the Communications Act of 1934, as amended.

9. Pursuant to applicable procedures set forth in Section 1.415 of the Commission's Rules, interested persons may file comments or or before July 15, 1965, and reply comments on or before July 30, 1965.

All relevant and timely comments will be considered by the Commission before final action is taken in this proceeding. In reaching its decision, the Commission may also take in account other relevant information before it, in addition to the specific comments invited by this Notice.

10. In accordance with Section 1.419 of the Commission's Rules and Regulations, an original and fourteen copies of all statements or comments shall be furnished the Commission.

FEDERAL COMMUNICATIONS COMMISSION
Ben F. Waple
Secretary

Attachment: Appendix
Adopted: March 31, 1965
Released: April 1, 1965

APPENDIX

PETITIONS INVOLVED IN THIS PROCEEDING

PETITION NO.	DATE FILED	PETITIONERS
378	November 5, 1962	Chester L. Smith Bedford, Massachusetts
455	June 5, 1963	Roy R. Cone Chicago, Illinois
470	August 9, 1963	Walter A. May, Jr. Simon Kahn, Stanford G. Houghton, Stephen M. Newmarl Los Angeles, California
474	August 26, 1963	Alex S. Labounsky Oyster Bay, New Yorl
480 and 481	September 11, 1963	Ellen W. Ackerman Panama City, Florid
499	October 3, 1963	American Radio Rela League Newington, Connect cut
516	October 28, 1963	George H. Goldston Bloomfield Hills, Michigan
517	October 28, 1963	Lowell E. White Elmwood Park, Illino
538	November 22, 1963	Leland W. Aurick, George S. Gadbois Columbia, Pennsylvania
577	March 3, 1964	Wayne Green Peterborough, New Hampshire

There are many good aspects to the dock . . . and some weak spots. The weak spots wi probably draw criticism, while the good a pects may get overlooked in the fray.

** Consideration will also be given to the assignment of call signs having a two-letter prefix and a one-letter suffix (e.g., WA2B).

Novices

The docket proposes to extend the Novice license to two years and delete their two meter phone privileges.

It is a shame to pick on Novices this way . . . they are new and unorganized . . . even more so than the rest of us, and that is a pretty bad state of disorganization.

Two years? Why? What will this accomplish? First of all it will put the final judgment day far enough off so that most Novices may be able to get used to the operating they are permitted to do and forget about trying to get ready for the General Class license. One year doesn't seem very long and it makes you hop right to work . . . two years is a heck of a lot longer and I think it will be very bad for Novices. It certainly doesn't take two years . . . or even one full year . . . to pass the General license test.

Two meters. Since a certain percentge of the Novices will obviously be interested in getting a Technician license instead of a General, why keep them off this all too sparsely populated band in the interim. They can use their time on two meters to very good advantage getting practical VHF experience and applying it. When you consider that we have about 60,000 Techs and only 95,000 Generals you can see that a high percentage of Novices obviously will be heading for this license. Why stop them?

On the other hand, only a small percentage of the Novices do spend any great amount of time on two meters. Thus the removal of this privilege would not work any serious hardship on more than two or three per cent of the Novices.

Advanced Class

The bitterest pill of all has been spooned to the Advanced. Fellows with up to 50 years or more in ham radio are understandably furious with the ARRL for having precipitated this personal disaster on them. Their feeling about losing their privileges in half of the phone and active CW bands is about the same as a doctor might feel after being licensed for years and then finding that he has to go back to medical school again and learn the answers to all of the questions on the latest medical exam. His years of service and wealth of practical experience are worth nothing and he has to start over with the youngsters . . . back to school.

Some compare it to asking a lawyer with years of practice to go back to law school and prepare to pass the latest bar exams. The parallel is apt. The concept is revolutionary. The anger and frustration are monumental.

Technicians

Outside of being moved up on six meters a bit, most Techs won't be affected by this proposal. In my experience most Techs are quite satisfied with six and two meter operation and are little interested in the lower bands. They have made a good adjustment to the barrier we have placed between them and the rest of us because they have balked at our antique code requirements. Perhaps this is a lesson to all of us . . . perhaps we will all accept our new frequency assignments with as little upset as the Techs have accepted their limited existence.

Two Meters

When they set about hacking up two meters they are goring my own personal ox, to use Huntoon's snide phrase. Though I'm not terribly active there and haven't gone out after glory and records, I have been around the band since it started.

Two meters is not a healthy band. It has been suffering from Tech-split for many years now and the infection has held it back. The ARRL had the right idea when they petitioned for the Techs to get the entire band a couple years back. Though there are a lot of Techs on two meters, I know of very few who were incentived to get their General license so they could go to the low end of the band. All that dividing the band up accomplished was to give us two much weaker bands, one for Generals and one for Techs . . . with not much congress between.

Reserving the lower megacycle for First and Extra licensees would probably kill off the little colony on the low end and get every one together above 145 . . . which would eventually qualify the lower megacycle disaster area for some other service than amateur. Right now there is a lot more activity above 145 than below in most areas of the country.

Six Meters

Though they don't say so specifically, it seems as if the docket will revoke the present CW band from 50.0 to 50.1 mc. This is just as well, as very little use has ever been made of this segment. This is what I said would happen back when they put it aside. I fought the change, but the ARRL overwhelmed me and it went in anyway. Their CW band up on two meters has had just as much use. Silly stuff. The ARRL, if you will remember, petitioned for it.

Six will be split up a lot the way two is today, with the bottom 250 kc for Extra and First. I predict that if this is done that the 250 kc will be virtually unused . . . thrown

away. Those few Extra and First licensees that use six will settle around 50.240 or so, just as on two meters there is a big crowd around 144.9 mc. If the FCC or anyone else thinks for a minute that the desert between 50.00 and 50.25 is going to exert even the slightest pressure to induce Techs to get a First Class grade license then they should look up a good psychiatrist for they have left the world of reality and are projecting fantasies.

75 Meters

While the loss of 3800-3900 will not affect half of the denizens of 75, it will be a serious loss to the small band of DXers and those of us that come out from under the rocks for contests. Contesting and DXing will no longer be possible without the Extra license for CW or First for phone. Eventually I suppose that most ops will get their First or Extra and this 100 kc will be as crowded as any other, but for a few years it should be like playing in a vacant lot to operate there. On the other hand, the high half of the band can't really get a lot worse than it is now, except that round tables will have one hundred participants instead of only fifty. We'll all have time to check in, if we make it short . . . never mind checking out . . . check anyone out after two hours if you don't hear him recheck in.

40 Meters

Those now operating in the 7200-7250 segment will find other Radio Moscow and VOA powerhouses to compete with when they move up. Good luck to you all. RTTY will have to move off 7040 to leave room for the Extras to work all that DX in "DX-Alley."

20 Meters

Here is where not having an Extra will really hurt. All that DX on the low end will be working Extras . . . not *you*. Same in the phone band. 14.000-14.050 for CW and 14.200-14.275 for phone. Of course a few DX stations do come up into the sideband end of the band . . . but they'll get out of there when everyone is squeezed up to that end of the band.

I expect that DXing is on of the activities that most of us General and Advanced will miss the most. With the new allocations it will be extremely difficult to work much DX any more . . . except when ten meters opens in a few years. Well, perhaps the FCC has lost interest in the international goodwill part of Basis and Purpose. Now that we have reciprocation perhaps they are depending on foreign hams to come over here and work us.

Call Signs

The League seems to be very worried about this one. I note that League officials are rushing around talking to as many clubs as possible, trying to get support for the docket, and they preface their talks with, "Neglecting the proposed change in calls, what objections do you have to . . . ?"

How do you neglect something like that? My call is just like a name to me . . . isn't yours? I've been known as W2NSD for 25 years now, except for short periods as W4NSD and W8NSD . . . and I sure hate to think of being KA1PJ or something. Very disturbing.

Apathy

But, as I read through the FCC release in detail . . . reprinted here for your perusal . . . I can see that the handwriting is on the wall. I don't believe that anything I can say or do will stop the power of The ARRL Clique. Certainly one little editor up in New Hampshire can't even begin to beat down the political influence of Herb Hoover Jr., et al.

The Future

I expect that the new regs will be passed pretty much as proposed. I predict a lot of grumbling . . . a few soreheads will quit ham radio in disgust or fury . . .we'll have a lot of Extra and First Class licensees . . . and then there will be a general settling back into the new pattern of things. In five years I doubt if we'll notice much difference.

Sure, a lot of us are going to have to struggle with the code . . . we will curse it as a hangover from ages past and of little value in our modern world . . . but we will get it up to 20 wpm this time before we stop using it instead of 13, hoping that something like this never happens again. I'll bet that most of you phone men can't copy much over 8-10 wpm right now . . . and I'll bet that you'll be right back there within two years after you get your Extra or First.

The theory will be a nuisance to have to memorize again. If only it had something more to do with operating or building. Well, we did it before, we can do it again . . . and we'll have the new ARRL *License Manual* to memorize from . . . the League should make at least $100,000 out of the new Manual, including all the advertising in it.

I don't know about you, but I've got the Epsilon record out and I'm working to get the Extra. You watch for WA1YN on twenty one of these days, y'hear?

Comments Received

While I had planned to print the better letters received on 15928, the large number received has overwhelmed me. Many of them are quite well thought out and very few are

just emotional outbursts in outrage. Now, if I've received over 550 comments on the Docket, imagine what must be happening down in Newington! About 10% of the comments here are in favor of the docket, though many of them have reservations about the call letter changes.

Let me briefly cover some of the arguments brought up in the mountain of comments: Ham radio is a hobby so how come we have to pass license exams which are just as stiff as those for professional licenses? The Advanced Class (Class A) are getting a dirty deal since they are all older hams and would find studying for a new exam far more difficult than a youngster would. Why is CW necessary for the phone man? If we bring RTTY gear to the FCC exam can we use that instead of CW? In case of emergency we need experienced operators not engineers and CW speed demons. 50 kc is far too wide for the few Extra Class licensees and foreign commercial and government stations will have a field day in the choice empty bands. Foreign governments don't care whether we are engineers or idiots, all they want are our frequencies. We should enforce our present laws instead of building law on law in a patchwork quilt to solve problems. The proposed changes won't accomplish anything. The Extra Class license should be awarded to amateurs who provide extra service. We should work out a system of policing ourselves instead of depending on the FCC to do it. Where does ARRL get off bringing this mess down on us with their RM-499? Is it true that there are only two Extra Class licenses in the ARRL HQ organization? Instead of splitting up the already overcrowded phone bands why not recognize the present preponderance of phone and open more phone bands for the higher class license? How about opening 3575-3625 kc for phone so we can work DX phone stations on their own frequency? How about phone on 7175-7225 kc for the same reason? And phone on 14150-14200 is long overdue. These largely unused bands are being filled with foreign commercial stations and should be opened to amateur phone. 13 wpm is more than high enough speed for code, for when conditions are so bad that sideband won't get through you certainly aren't going to make it with fast CW. Old timers will have great difficulty in increasing their code speed, and some have trouble writing these days. Segregation in the ham bands is a bad thing as we certainly have learned on our only segregated band, two meters; so why duplicate a proven loser? The big problem we have with amateur radio these days is a few inconsiderate operators and, unfortunately, these are probably the first that we will see on the new bands. The amateurs who are bettering the state of the art will do this without any special licenses; certainly no ham is going to brush up on his theory to pass a test and suddenly come up with a new discovery for us all as a result. No other field grants licenses and then later takes away the privileges granted by the license. The First Class license seems unnecessary, however if it must go through the Advanced Class licensees should be automatically upgraded. The Technician license should be returned to an experimenter's license and phone privileges should be removed from two and six meters. All amateurs should have to pass a 20 wpm code test. The Technicians should be given a CW band so they can learn the code. One letter calls will be good for special events. Two letter calls will be good for club stations. The docket quotes individual "experts" who are unnamed, but sound strangely like certain influential League supporters who are well known for their bias. The docket suggests that the 85,000 ARRL members are in favor of RM-499, while an actual count of the comments by an impartial group of amateurs showed that only a fraction approved. At present only 33% of the amateur bands are allocated for phone, yet surveys show that over 75% of the present day operation is on phone and that less than 20% of the amateurs spend more than 50% of their operating time on CW; isn't it time that the phone allocations were expanded? How many hundreds of more FCC employees will be needed to administer the new tests and is there any precedent in history for even one of these men to *ever* get fired? Since docket 15928 obviously does not provide a solution to the problem perhaps a survey and fact finding committee should be appointed by the FCC to come up with recommendations. Message handling and nets should be curtailed to open more frequencies. CW is a dying mode so why not reduce the code requirement to eight or ten wpm, which is satisfactory for emergencies? 15928 will do the job with a minimum of relocation, let's not squabble over minor details. The newly proposed bands would virtually eliminate DX work for anything but Extra on CW and First and Extra on phone. Class distinction will make more friction. What will new calls do to presently held permanent call letter license plates? How much will ARRL make on their new "First Class License Manual?" The Advanced Class license should not be down-graded to General.

You get the idea.

It Seems To Me

After considering all aspects of the docket I am certain that the FCC put in that bit about changing the call letters as a smoke screen to ease the rest of the docket through. The idea was to present something extremely unpalatable that they could change in the final rules, thereby relieving all of us. In the meantime, while we fuss and fret over the threatened call letter changes, we may let the other parts of the docket go through by default. If they do adopt a system of identifying call letters, I expect they will use a system such as I proposed in RM-577 (see May 1964 73 page 89) wherein an extra letter is added to indicate the class of license.

What I'm saying is, don't spend so much of your time and effort fuming over the call letters that you lose sight of the rest of this package and what it will do to ham radio.

What To Do

Docket 15928 is such a jumble of blunders that desperate measures are called for. First of all, present your reasons why you think it should be killed outright and send them with the usual 14 copies to the FCC, Washington 25, D. C., marked as comments on docket 15928.

Now, when you have that bundle sent off, write a letter to your Senator or Representative, explaining to him briefly what your problem is and making sure that he knows that you want 15928 killed outright. Your Congressman will already have a letter from the Institute of Amateur Radio explaining the basics of the situation, so you won't be approaching him cold.

Finally, and by far the most important of all, one more man should have a letter from you on his desk. Have you ever gone round and round with the Customer Relations department of a big company? Have you then, in desperation, written the president of the company? Well, if you've done this then you know that your letter to the president of the company invariably gets you action . . . good fast action and satisfaction. The Man in this case is Senator Warren G. Magnuson of Washington and his address is 127 Old Senate Office Building, Washington, D. C. 20510. Be sure to write Senator Magnuson, explaining briefly your arguments against docket 15928 and send a carbon copy of your letter to FCC Chairman E. William Henry, FCC, Washington 25, D. C. 14 copies not needed for these gentlemen.

The explosion from 15928 has been so resounding that I understand that there is considerable pressure for a Congressional investigation of the matter to see what happened and why and who made it happen.

We *do* have problems in ham radio. I think that idea about turning a committee loose on the problem is a good one. The first thing we need is a statement of the problem . . . and from there it shouldn't be so difficult to work out some reasonable answers. But first of all, let's get that 15928 out of here. The responsibility for what happens to ham radio is yours . . . if you speak up we can keep a pretty fine hobby going . . . if you don't holler now then we all will suffer.

What Can Be Done About The ARRL Clique?

Letters from all over the country ask the same question: "What can *I* do to help?" I'll admit that this is a tough question. One thing I do know: none of the normal ways are going to work. Serious hams are understandably concerned over the ruthless and destructive direction the League has taken under the new controlling clique. They read the documentation on one disaster after another in K6BX's *Newsletter* . . . they watch ham magazines crippled and killed for opposing The Clique.

What *can* the average ham do to fight The Clique? Well, The Clique has an answer for that . . . if you don't approve of what is going on all you have to do is tell your director and if he doesn't make things right vote for a new director. This is a wonderful answer . . . so democratic . . . so ideal. And they are laughing up their sleeves because they know full well that they have things under complete control and that all anyone can possibly do through regular channels is to wear himself out without even a ripple being felt in Newington.

If we can't get a message to the top using the methods suggested by The Clique and repeated in *QST* and all dutiful member club bulletins, how can we let them know that we are opposed to their actions?

Simple, really . . . there is one way to reach them with a loud clear message: Join the Institute of Amateur Radio. This is one thing that they understand. They are frightened of the Institute and are fighting it in every way they know . . . through attacks in controlled club bulletins . . . through letters to member clubs . . . through fellow-traveling *CQ Magazine* editorials and through attacks and insinuating comments at hamfests, conventions and club meetings.

The ferocity of their objections to the Institute tell you clearly that this is the most effective answer to The Clique. If you join the

Institute . . . and all the members of your club join the Institute . . . it won't be long before even The Clique will understand that they are not omnipotent . . . and it won't be long before the ARRL directors face up to their responsibility and update the management of the League. This will be a move that will help ham radio more than any other single action yet conceived.

I look to the day when the Institute and the League are able to work together . . . possibly even join . . . and carry out the programs of each organization for the betterment and survival of amateur radio. I believe that all of us should support the organizations that are working for our benefit . . . and right now this means the Institute.

Advertising Executive Wanted

One of the reasons why 73 hasn't more advertising is that I have been the sole ad salesman . . . a job I am psychologically unsuited for. Each month I know that I should call prospective advertisers and encourage them to patronize 73, but I get so depressed when I'm turned down that I use every possible excuse not to make the calls. I'm afraid that I must admit that most of our advertisers are using 73 because they took the initiative and called me first. Lousy way to run a business.

What we need here most desperately is someone who can take a no with a smile. There is no question in my mind that 73 is the best deal by far for advertisers and that every manufacturer and major distributor would be advertising in 73 every month if only someone here knew how to get the story across. Few magazines in any field can come up with the advertising success stories that we have in our files.

The question is this: is there one ham among our readership who has a good background as a salesman . . . knows his ham radio . . . who would enjoy the unconventional life up here in the New Hampshire mountains . . . and who is willing to gamble on our growth? With a good salesman I am convinced that we would not just stay a little ahead of CQ in pages of advertising, but could out do QST.

Salary? I'm offering an unusual deal . . . hoping for an unusual man. I'll pay a salary on a percentage basis . . . the more sales the higher the salary . . . 5% of our advertising income. If we had QST's ad income this would be in the neighborhood of $$20,000 a year . . . and if we can expand to that it will be worth it. We're only making about a third of that right now.

If you really think you can do the job and have enough background to make it a good bet for us then send in a resumé and we'll talk it over. Send resumés after June first since I'll be in Europe during May.

For Sale?

I understand that another publisher has been gossiping about me again. Tsk, tsk. This time the word is that 73 is for sale and I'm quitting. Oh, what wishful thinking that is.

Dxing

As a matter of ego gratification I thought I'd mention a "typical" day in the life of a test pilot for ham gear. On May 3rd I was testing the Henry 2K linear (what a tough life we editors live!) and I spent about nine hours on twenty meters. During that time I worked 160 stations, including the following DX; in the order contacted: KL7, KX6, PY, VE, XE, ZK1, GW, G, DJ, FS7, KR6, UQ2, MP4, OZ, 4X4, GM, F, CN8, SVØ-Crete, UB5, UD6, LA, VP9, 9G1, VP2, TG9, ZP, HC, VP1. This was all on SSB, by the way.

As we go to press I have been operating twelve days with the 2K, about 3-4 hours a day, and I have contacted 100 countries.

Personal Stuff

After living up here in ski country for over two years I finally got hornswaggled into trying to ski. I managed to put it off until April first, so I only had four days in which to endanger my life. I loved it . . . and, with some top instruction, I got so I could get around quite satisfactorily. I'm hooked.

Not satisfied with surviving the ski season without even one fall, I decided it was time my Arab stud, now three years old, had someone on his back. May I take this time to highly recommend that you 42 year old desk jockies don't stupidly go out and jump on an unbroken Arabian Stallion. It only hurts when I laugh . . . one broken finger and two cracked ribs.

Just after this issue goes to press I'll take my ribs over to Europe to attend the ITU 100th Anniversary doings plus a visit to as many VHF ops as I can manage. I'll be back in time to put a few words in the next editorial, if I don't get arrested in Hungary, Czechoslovakia or East Germany.

We're getting ready for the big do up here on July 4th . . . I sure hope you are planning to come. I'll have tour guides for seeing the most beautiful state in the Union . . . New Hampshire, plus visits to our humble abode and the 73 mountain shack. You'll have a chance at my unbelievable collection of ham gear at the auction . . . plus cash for your own stuff if you bring it for the auction. Looks like a ball.

. . . Wayne

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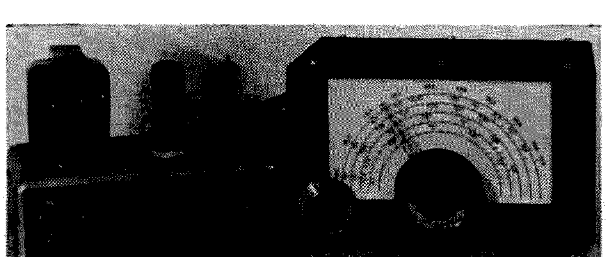
A VFO With FSK Provisions

I operate both teletype and sideband and I wanted a minimum-drift VFO with frequency-shift keying provisions. One fact I learned some time ago was that an excellent way to minimize drift caused by heat is to isolate the tuned circuit in one box and the heat-generating components elsewhere. Also, let the VFO run continuously. Keying the oscillator can be a cause of drift.

I have learned that it is important to use leads as short as possible in the tuned circuit and make them of #12, or heavier, wire. If the length of the lead is much over an inch or so, it should be supported at mid-point by a ceramic standoff insulator. Make sure, too, that all components in the tuned circuit box are securely fastened down. You should be able to pound on the surface on which the tuned circuit is placed without having the frequency change.

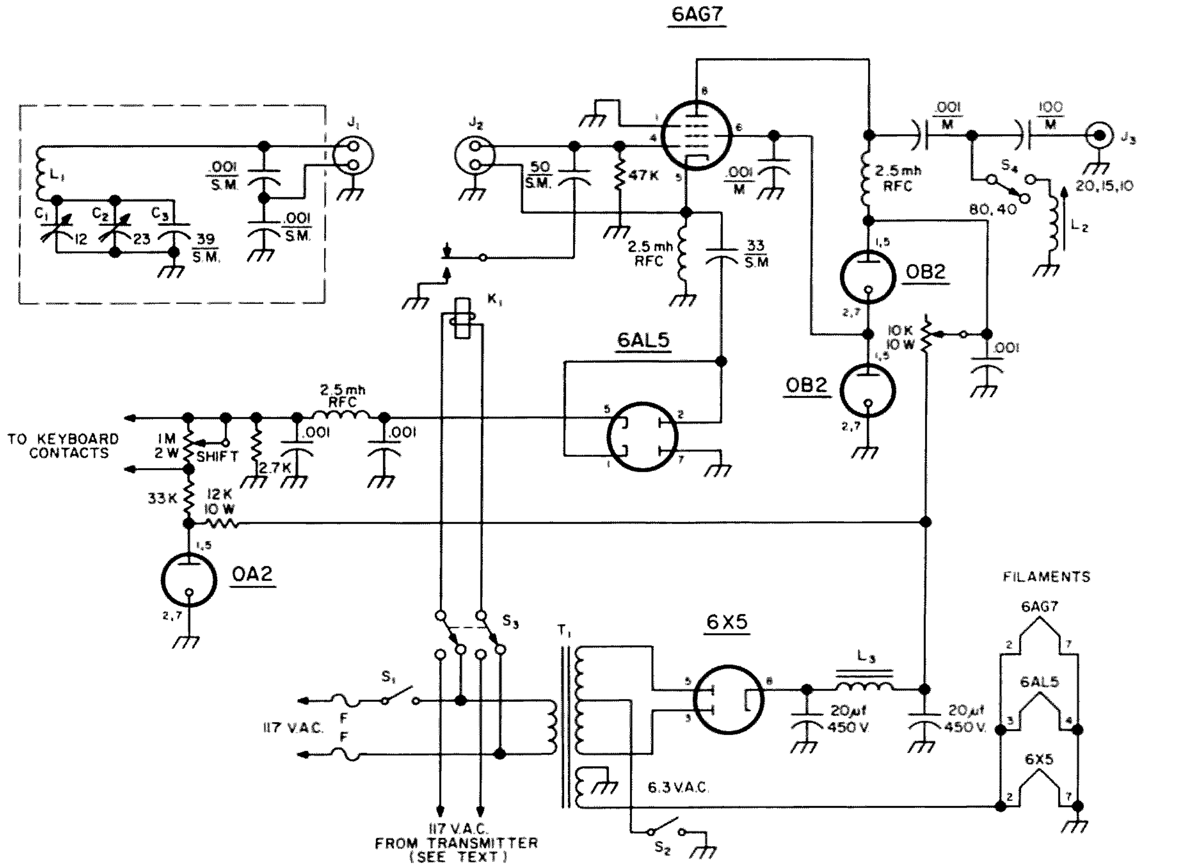


Front view of the two units. The connecting RG-22/U cable is seen in the background.

Shown in the photos and in Fig. 1, this VFO uses a series-tuned Colpitts circuit, with a 6AG7 as the oscillator tube. The plate voltage is regulated at 216 volts, and the screen-grid voltage, regulated at 108 volts, is taken from the point between the two OB2 regulator tubes. A little more output can be obtained by increasing the screen voltage to equal the plate voltage, but since this VFO is not intended as a power-generating device, we used the lower voltage for the screen grid. Adequate drive to our exciter, which uses a 5763 buffer and a 5763 buffer/multiplier driving a pair of 6146's, is obtained from 80 through 10 meters.

The coil L2 is slug-tuned to resonate in the 40 meter band. Additional output is obtained on 20, 15, and 10 meters by switching the coil into the circuit. It is switched out of the circuit during operation on 80 and 40 meters, resulting in an untuned output circuit. With most transmitters, the coil should not need to be in the circuit in 40 meter operation.

A trick we used on a two-meter VFO, described in 73 last year, was also employed in this VFO. The idea, originally supplied by W6CEM, allows the VFO to run continuously thus eliminating keying the oscillator. The relay, K1, is used to add 50 pf capacitance to the 6AG7 grid circuit during receive periods



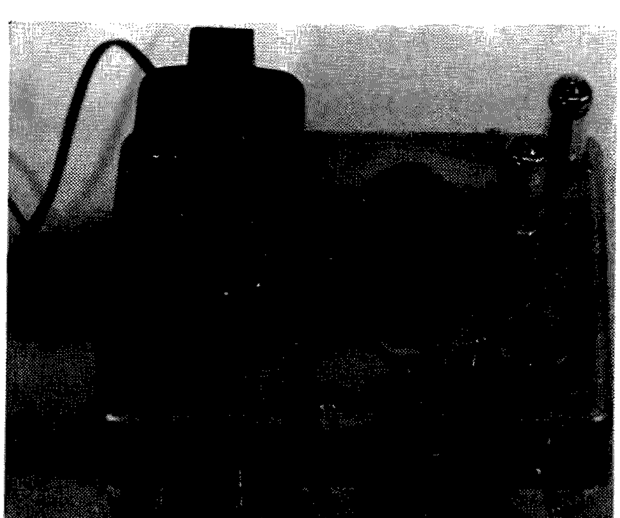
FSK VFO

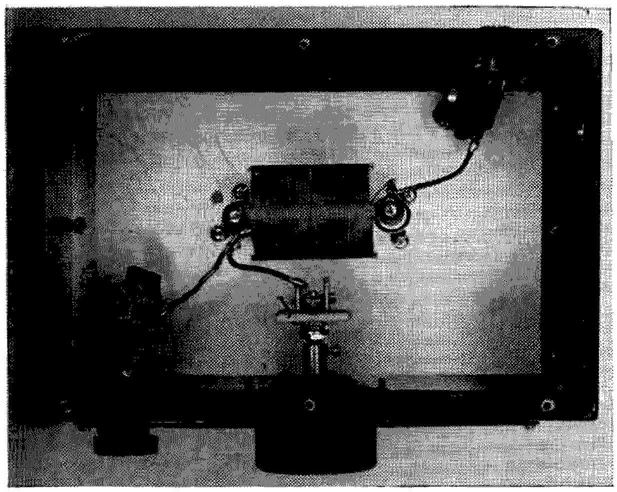
This capacitance takes the signal from the VFO far enough down the band, even on 80 meters, so that you don't run into your own signal when tuning around, unless you are listening 15 kc (on 80) away from your transmitting frequency.

To zero-beat a station, the dpdt switch, S3, applies 115 vac to the relay coil, closes it, and removes the added capacitance from the grid circuit. During transmit periods, the relay obtains its 115 vac from the transmitter transmit/receive switch. If your rig does not contain such a feature, it should be easy to add. In our transmitter we use a dpdt switch to provide 115 vac for the VFO frequency-change relay and for another relay, located in the transmitter, which grounds the oscillator and final cathodes during transmitting.

The frequency-shift keying circuit is straightforward and has been covered thoroughly in other literature. Briefly, the 6AL5 acts as an electronic switch. When the tube conducts, it

Top view of the oscillator-FSK-power supply chassis. The OA2 voltage regulator tube, for the FSK circuit, is at the right rear of the chassis. The two OB2s, for the oscillator circuit, are to the left and ahead of the OA2. The shield at the front right corner covers the 6AL5 FSK tube. The 6AG7 is located directly in front of the octal socket, which provides connections to the teletype machine. The 6AX5 rectifier is to the left of the 6AG7. The slug-tuned output coil is located to the left of the 6AL5. The ac power connector, in the background to the left, is an Elmenco fused plug.





The tuned circuit box. The two .001 uf silver mica capacitors are mounted at the twin-axial connector.

Parts List

C1—Cardwell PL-6001 with last rotor plate removed.
C2—Hammarlund HF-35 with last stator plate removed.
J1, J2—UG-103/U panel-mounted connector.
J3—RCA phono plug.
K1—spst relay, 115 vac.
L1—Barker & Williamson 80-BCL coil with link and base removed.
L2—30 turns #26 enameled copper wire wound on 3/8-inch ceramic form, slug tuned.
L3—Broadcast receiver replacement-type choke.
P1—Elmenco fused line plug.
S1, S2, S4—SPST toggle switch.
S3—dpdt toggle switch.
T1—Stancor #PC-8418 power transformer (230-0-230 volts @ 50 ma; 6.3 V @ 2.5 a).

connects the 33 pf silver-mica capacitor to ground, through the tube. Voltage for the 6AL5 is obtained through the one megohm potentiometer, which determines the amount of the shift. The OA2 voltage regulator prevents changes in line voltage from affecting the amount of frequency shift once it has been set by the potentiometer.

Using the values shown in the FSK circuit, sufficient frequency shift is obtained on 80 meters to allow 850 cycle RTTY frequency-shift keying. The shift potentiometer allows the shift to be varied appropriately for the band in use.

The tuned circuit is built in an aluminum utility box, black hammertone finished, 5″ × 6″ × 9″ (California Chassis #CAB-5). The coil, B & W JEL-80, has the base and the link carefully removed. The remaining polystyrene mounting rod is mounted on two National GS-1 pillar insulators, which, in turn, are mounted on the bottom of the box. The bandset capacitor, C2, is mounted in the lower left-hand corner of the panel. You will have to drill a hole through the edge of the National ACN-1 to mount the capacitor. The 39pf silver-mica capacitor is mounted across the bandset capacitor terminals.

Any good-quality three-terminal connectors can be used on the tuned circuit and oscillator chassis. I used UG-103 connectors, but these are not polarized, and it is essential that the connections between the tuned circuit and oscillator chassis be made as shown in the schematic or the unit will not oscillate. I used small globs of red paint on the panel and cable connectors to indicate polarization. RG-22/U two-conductor shielded is the cable used.

The oscillator, frequency-shift keyer, and power supply are built on a deep-drawn aluminum chassis measuring 8″ × 5½″ × 2½″. I must have scrounged the chassis from somewhere, but from where I do not remember. The chassis does not seem to be commercially available, and the two Bud or California Chassis Co. chassis nearest those dimensions are 2½″ × 9½″ × 5″, and 2″ × 9″ × 7″. Take your pick; either will be adequate.

A word of warning: When building a VFO don't try to save money on, of all things, capacitors. Buy good-quality silver-mica capacitors for both the VFO and FSK circuits. The familiar, inexpensive ceramic capacitors may be fine in some applications, but they do not belong in any frequency-determining circuit.

The VFO was calibrated by using a BC-221 frequency meter. The initial calibrated dial was accurate but unattractive, so a new dial was drawn, using a compass and india ink, and the calibration points marked through the first dial onto the new one by holding the two dials in perfect alignment and making calibration marks on the new dial. The two dials were taped to a window facing the sun, so that the original dial markings could be seen through and onto the new dial. The numbers are "Instant Lettering," a very handy source for letters and numbers. The letters and numbers are available in large sheets and are applied simply by burnishing them onto the surface to which you want to apply them.

We've been quite satisfied with the performance of this VFO, and hope you will be, too. Drift seems negligible, even when "coming on cold."

. . . W6TKA

William F. Hoisington K1CLL
Peterborough, N. H.

Shoulder-Strap Portable

There are times when several developments that seem to grow up more or less independently can be assembled together in what the French call a "happy marriage." This is the case with the instant-heating 5816 tube; the really non-spillable, non-gassing, small and low-cost storage battery; good portable beams; practically wattless low-noise transistor receivers, and last but far from least, the increasing occupancy of the VHF bands, namely, 6 and 2, where reasonably sized portable antennas are practical.

When put together, these ingredients make for a new-type of amateur station. This is the shoulder-strap portable rig, a real emergency type with which you can get out and away from the car, walk (or climb) up that mountain or five tower for an additional 50 to 500 feet of elevation. (This also gets you away from super-regenerating Six'ers!) For *real* camping it is excellent, and it is always a nice thought to have a good, selective, complete emergency rig on hand. (One that doesn't need an AC plug!)

Starting with the 5816 tube, we find here a little marvel: the miniature equivalent of a 6L6GT. It uses 6 volts, but is instant-heating. This means what it says. You do not have to leave the transmitting filaments on while receiving. This type of operation is no news to mobile rig designers, but there seems to be a great number of amateurs that are not familiar with it. Don't forget that while receiving, zero transmitter power is used, and you have to carry that power.

There is only one precaution with the 5816. Do not run the screen at more than 75 volts. This is a red-hot beam power tube and will perform miracles when used right. It also uses only 225 ma of filament current.

Now for the circuit: Fig. 1 shows the 3 tube 6 meter unit. Nothing has been left out. It has 100% modulation, crystal control, and runs up to 7½ watts input, but to play it safe, keep it at 5.

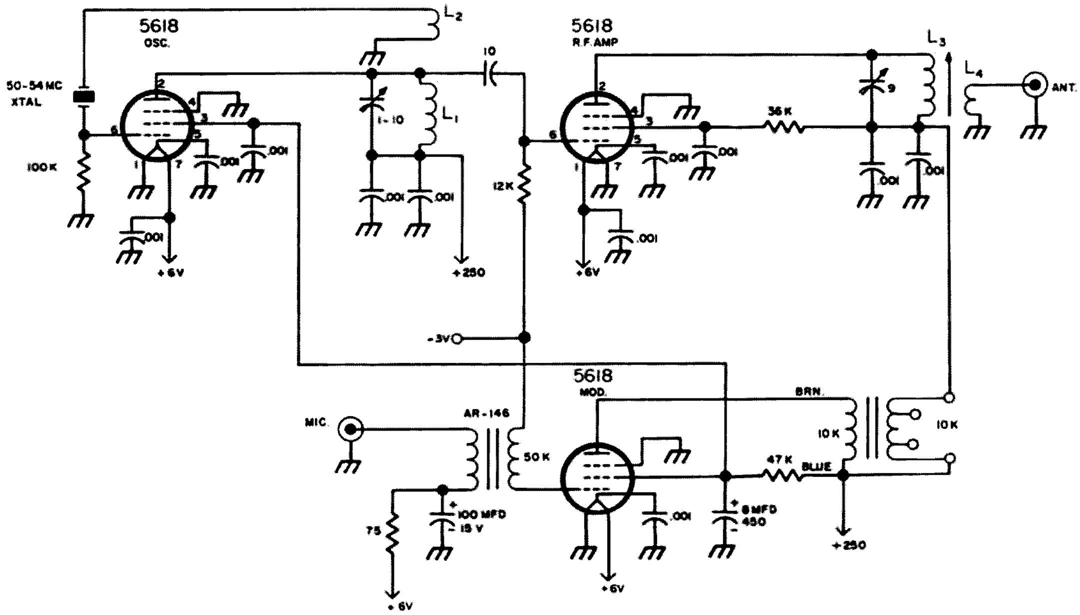
Much has been written about VHF crystal oscillators and a lot of work has been done on them. The one shown has patents pending (yours truly) and is the result of many years experience.

Just be sure and use *non*-regenerative feedback coupling in the grid-crystal circuit from the plate. This prevents all oscillation until you reach the crystal resonant frequency. At this point (crystals with ac on them always develop plus voltage on one side, minus on the other, at any given moment) the crystal will reverse the phase and apply good regenerative voltage to the grid. A lot of handbooks tell you to use regenerative coupling to help VHF crystals. Well, here is one circuit that works better the other way!

The plate circuit uses the well-known B & W air-wound coils. Every amateur should have a selection of these on hand for any and every use. They do work much better than slug-tuned coils if you have the room, cutting down TV and FM harmonics and pulling in 6 meters only! Copper-clad bakelite makes a good easy-to-build base, and provides an excellent ground. Don't forget the VHF and up rule: a "ground" is a place where most all of the rf has been brought to a halt. You can bring bypasses, coil returns, tube filaments (in this rig) etc., to this point and they will stay quiet. The trick with the copper-clad bakelite is mechanical strength, light weight, and it solders with a touch-of-the-iron.

A good trick in the B+ bypassing for rf coils at VHF frequencies is to use more than one capacitor. Just be sure of the voltage rating. When you do this, you can ground the shaft of the tuning capacitor rotor. There is some choice in CV1. If you stay within half of a megacycle on the band this can be a trimmer. If you want to cover 50 to 54, bring the shaft of a Hammarlund midget out to the front panel with a piece of insulated shaft.

Use light coupling to the final grid. This doesn't load the oscillator too much, and re



Shoulder-strap portable.

member that the 5816 is red hot and doesn't need much drive. The final grid is furnished with bias as a precaution.

The rf final has the capacitor CV2 directly across the coil. It is better to take a little time for this for this is where the *power* is, and a class C amplifier needs every drop of "Q" it can get. Mount CV2 on a separate piece of bakelite, using an ***insulated*** shaft on it.

A swinging link completes the output circuit, unless you want to couple in a power output monitoring diode at this point. (We did.) Couple it to the antenna jack, not the coil. With a little more work you can make the link adjustable from the outside. (We didn't.)

The modulator uses a carbon mike. (You cannot use a crystal mike without considerably more circuitry and battery drain.) If you use Western Electric F1 surplus buttons, the quality will be definitely good. A high gain transformer, Argonne (Lafayette) no. AR-146, primary 30 ohms, secondary 50 k gives plenty of audio drive on the grid. Incidentally, we have used a transformer with a 300 k secondary with even better modulation. Be sure to use the voltage dropping resistor and bypass shown for the mike voltage. 1.5 volts is ok. The modulation transformer is a standard low-cost job just suited to this purpose and rated at 5 watts. Connect it as indicated on the diagram.

Any dc to dc converter may be used, but do not go over 300 volts. 225 or 250 is plenty. A power saver switch on the supply, cutting the B+ to about half, is a good idea for local contacts. Don't forget, if you use this rig on a mountain top with a good portable beam, you will soon be surprised at the stations you consider "local"!

A word of caution here. Dc to dc power transistor circuits generate "spikes" on every possible occasion. Barrels of "dead soldiers" in many labs across the country have been the result of those reverse voltage spikes. The trick lies mainly in the transformers and, of course, push-pull. Barker and Williamson furnished this transformer. Triad also manufactures this type of unit. Maybe you should buy a ready-made kit. Anyway, this one has worked well now for over a year with no trouble. Incidentally, due to the low-drain receivers used, this supply is only turned on with the transmitter filaments.

And now for the portable battery that has the energy stored in it to get you on the air on that hill top. "Miracle" batteries have been featured in many articles since the war. Some of them really are miracles. Batteries small enough to be swallowed in a pill; batteries you can hold in your hand and that will furnish a kw of power (for one minute!); a D size flashlight cell with 14 ampere-hours of energy stored in it (that one always seemed to me to a real miracle!); etc. However, when first cost, weight, size, ease of charge, explosive power, "seeing what goes on" inside and compatibility of voltage with available tubes, ditto with car batteries; are all carefully considered, I always seem to end up with the old reliable lead-acid battery, but in a new

form. There is a lead-acid storage battery that really does the job for portable amateur work. It has transparent walls so you can see the water level and condition. It has a really non-spillable baffle, vent, and plug arrangements so that only dry gas comes out when charging or discharging. I personally know this as a fact because I have charged and discharged this battery inside the case of the type of rig described in this article for over a year without damage to any of the coils or transformers! This is what is known as the "acid test."

Also, by starting with one small 6 volt unit and then adding more of them, you can get double ampere-hours (time on the air), or wattage (power on the air), or voltage (12 volt systems, or 24 volts for much more power), etc. However, here again there is a level above which it is better to use a straight ac gasoline driven generator. This of course, is beyond the definition of a "shoulder-strap portable." All this seems to show that there is going to be a power level limit for "portable" stations: that is, just how much power you can walk (or stagger) up a mountain with and then stay on the air for at least an hour or so.

Here are some suggested transmit-receive circuits for the 5 watter portable. A three-pole, double-throw slide switch has been used successfully for a year. Remember, this is still a low-cost station. Of the three sections, sw1 turns on the receiver filaments; sw2 switches the antenna; and sw3 turns on the 6 volts to the transmitter and transistorized dc to dc converter. A rotary 4 pole switch could also be used, but is more expensive.

Use coax cable right close up to the slide switch. This is ok at least up to 50 mc, especially if you use the copper-clad ground mentioned before.

For assembly of the complete rig, an arrangement consisting of ⅜″ plywood shelves, with ¼″ sides, and a dowel handle across the top will prove satisfactory.

For the antenna, two 4½ foot aluminum pieces with two banana plugs each (4 total) plug into banana jacks on a piece of bakelite bolted to the top of a piece of 5 ft. TV aluminum masting makes a fb dipole that packs into a 5 ft. long thin package.

All these items together used on a mountain-top put you quite a ways away from the usual idea of a "walkie-talkie" rig, as you will find out. Be sure to make the battery and hv supply detachable and have output sockets on it, as more portable rigs are coming for 2 meters, 432 mc, etc!

. . . K1CLL

Charles Spitz W4API
1420 S. Randolph St.
Arlington 4, Va.

Superimposing 6 meters on your Tribander

Now that SSB transmitting converters are firmly fixed on the scene, many amateurs are faced with the erection of another antenna or beam. While there is no argument against the efficiency that will be obtained when a beam is designed for a specific frequency and independent from other arrays, many cliff dwellers and others just in a hurry can take advantage of this shortcut which adds little or no weight or cost to the operation.

We have long been familiar with the technique of tying resonant lengths of antennas to a common low impedance feedline, and the popular trap triband yagis have this point in their favor. Several factors enhance the addition of superimposing a six meter beam to the multiband antenna. One is that six is not harmonically related to these bands, thus not disturbing or being disturbed by the lower frequency lengths. These lower frequency antennas at their current points will now present a high impedance to the six meter portion when operating on six. Another factor is that closed spaced arrays predominate the multiband beam system, permitting six meter operation using the non-critical quarter wave spacing between elements at that frequency. This factor means less critical adjustment of lengths, broadbanding and retention of coax line impedances.

The theory behind the superimposition is that part of the original elements are used for a quarter wavelength around the current feed point of the antenna. Electrical resonance for six, and decoupling from the balance of the antenna is achieved by "drooping" ⅛th wavelength at each end of this quarter wave, thus forming an electrical half wavelength circuit.

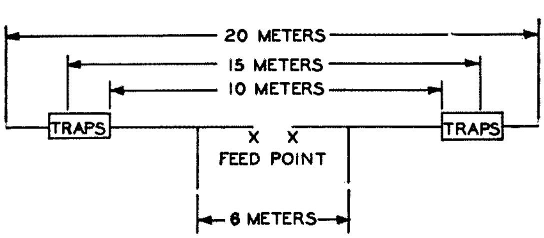


FIGURE 1

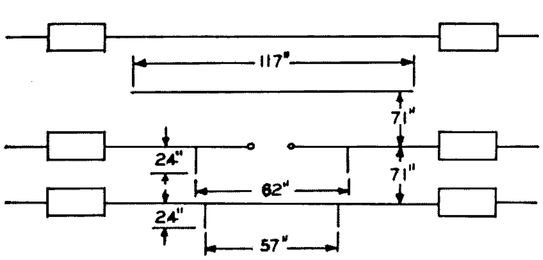


FIGURE 2

In order to visualize the physical structure, Fig. 1 illustrates a triband radiator element, in this case a Mosely TA-33, to which a six meter resonance is superimposed.

The final installation is shown in Fig. 2. The drops for the radiator and director for 50 mc are composed of 26″ lengths of TV aluminum No. 8 ground wire, two inches being bent at right angles and inserted through hose clamps which grip the wire and basic antenna element. The wire is oriented to hang downwards. Aluminum rod could be used, but the short length of wire presented no problem in the installation.

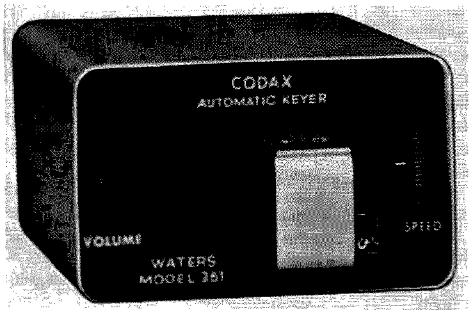
Since the reflector in this arrangement was more than a quarter wavelength on six from the radiator, it was decided to add a reflector element. Obviously, an additional close spaced director element could be added to make a four element array from the system.

The dimensions for 50.0 mc are a total of 110 inches for the radiator, consisting of the hose clamps spaced 62 inches apart, equidistant from the common feedpoint center line, electrically completed in resonance with the two 24″ drops. The director is 105 inches, using a 57 inch separation between hose clamps, also with two 24″ drops. The reflector is a half-inch diameter piece of aluminum tubing 117 inches in length, and 71 inches behind the reflector.

If an additional director were to be used, a 105 inch piece of tubing could be placed halfway between the original director and radiator, and the triband director, now the second, would be a total of 104 inches or 56″ between drops.

Obviously this is not the only application to which the superimposition system could be used, nor may these be ideal lengths and spacing for every situation and antenna. Lengths and spacings for 50.1 mc may be found on page 122 of the VHF Handbook. The system, of course, could be used with various types of antennas and for various frequencies. This should provide a fertile field limited only by the imagaination and application of the experimenter.

. . . W4API



Charles Leedham WA2TDH
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The Waters Codax

Somewhere in, under or around the new Waters Codax there must be the switch I'm looking for—the one that turns on the heating element under the top so it will heat my coffee for me while I'm operating. It does everything else, so I can't see why they would have left that simple feature out.

What the Codax does do is send code for you so automatically and effortlessly that it almost seems to be wired straight into the nerve-endings, taking out of CW operation all the old pain of whangety-whang-whang on a straight key until your fingers go numb. It is also an audio-tone keyer which will make a CW transmitter out of an SSB or AM transmitter. And to top it off, it is a keying monitor and even a practice key. Do you wonder I'm looking for the heater switch?

Sitting there on the operating table, the Codax is a little thing, a pale-grey box with rounded edges, about 2½ high by 4 by 4, plus 2 inches of double paddle sticking out the front. But touch the left paddle with your thumb and the dots start rippling out, touch the other with your finger and the dashes flow. And I do mean touch. You can set the spacing and tension of the paddles to such a delicate point that a hard look will trip them. This of course causes a tendency at first to spray surplus dots around like a jittery BAR man, but this comes under control with a little practice.

Specifications: the Codax is a solid-state automatic keyer with the paddles built right in, the only addition required being six small 1.35-volt batteries supply all the power. Dots and dashes are made with a blocking oscillator set into motion by the paddles. Briefly, pulses from the oscillator are sent to a flip-flop which in turn operates a relay at whatever keying rate you have set on the dial. For dashes, the same oscillator pulses feed a second flip-flop operating at half the dot rate, which then goes through a gate opened by the dash paddle. In short, a dash is made up of one double-length dot followed instantaneously by a single dot, all this put together by a summing circuit. This may seem unnecessarily detailed unless you are a student of such things, but a moment's thought will show that by this method the dots, dashes and spaces are all kept in their proper proportion no matter what the speed. Also, as Waters points out, you don't have to wait for a running dash-oscillator to get around to making a dash after you press the paddle—the oscillator starts when you press.

The speed can be set anywhere from 5 to 50 wpm, according to the specs. I only know that I have run it up to about 25 in practice, far beyond my ability to tap on a straight key, and it still sounds smooth and regular. I still can't copy 25, but one of the features of the Codax is that I'm sure I will be able to soon. There's a kind of sticking point you get to, somewhere between 15 and 20, when you can't send any faster than with a straight key, but I know my own copying rate has gone up two or three wpm after only a few sessions with the keyer. Things go smoother and quicker from text to code, and the reverse seems to begin to operate. Hearing yourself send faster and smoother—and you do hear it with the Codax—you begin to get the hang of what fast code sounds like, and up goes your speed.

And there's more. Just in case you have one of those transceivers without CW provision, you can use the Codax to send code USB or LSB. Along with pulses for normal CW, the keyer generates an audio tone of about 1500 cycles at .05 volts, which can be fed right into your mike jack. I've tried it. It works. The first dit trips the VOX and the last one lets it drop, and you have break-in keying, sideband style. It'll do MCW code on AM, too, but remember it's illegal below 50 megs, while audio-keyed SSB is OK anywhere.

For monitoring purposes, either straight CW or audio, there is a phone jack on the back of the Codax. Plug in your phones and the panel volume control lets you listen to yourself key. Also, of course, you can plug in the phones without connecting the keyer to anything, which is an excellent idea at first, while you learn to send letters instead of sprays of dots and dashes. Oh yes, and if you want to feed your receiver audio into the phones at the same time, which is logical enough, you plug an already-wired phone plug into your receiver's phone jack. A mixer inside does all the work for you.

The Codax has provisions for grid-block keying for use with the lower priced transceivers which have a tendency to produce clicks and thumps when square wave audio is fed into their filters.

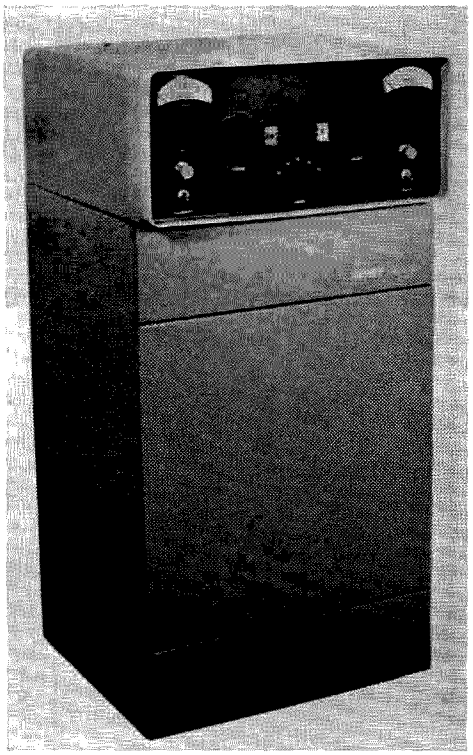
All the cables are already on the back of the box—one for wiring to whatever type of mike connector you use if you want audio keying, one with the phone plug, and one for key plug. In my own set-up, I just stuck the key-plug connections into the terminals of my straight key, so I'd have a way of holding key-down for tune-up (although you can tune quite nicely on a string of dashes), and also so I could go back and forth occasionally just for comparison.

There is, in fact, no comparison at all. In operation the Codax practically takes over the sending for you. The CQ DX's just ripple out, and in the course of QSO's I now find myself actually saying things, making conversation, instead of sticking to the old deadly round of RST, QTH, name, 73's es tnx fer fb qso om—keying is now so easy. I still spray an occasional extra dot or dash around as I keep pushing my copying and sending speed up, but, heh heh, it's right easy to send a string of "error" dits now.

Tired of that CW straight-key drudgery? Get fast (!) relief with Codax. . . . WA2TDH

Wayne Green W2NSD/1

73 Tests the Henry 2K Linear



For quite some time I've been watching those Henry ads for their 2K linear. I've puzzled over it. Last summer when I got out to visit the Henry emporium personally I was taken aback to see that what looked like a six foot rack full of stuff in the pictures was in fact a rather normal sized linear amplifier sitting on a two foot high pedestal containing the power supply.

I wanted one . . . but I wasn't really sure. I wondered about why it was so big (small as it was) compared to some of the other linears available. I read their literature . . . and I started asking around. I found out!

Suddenly I found out why fellows are buying the Henry linear.

I found out why it is bigger than the others.

I found out why they call it the 2K.

This infernal machine will run two thousand watts . . . and I don't mean PEP watts either, I mean two thousand dc watts into a wattmeter or, ahem, a dummy load. Using the usual nomenclature, this is a 4000 watt PEP amplifier.

When mine arrived I discovered that the instruction book gives full instructions for using it within the legal amateur limits.

Shortly after it came work on 73 stopped and we hastily took down the Oscar antenna and put the Cushcraft three element 20M beam back up on the tower. Then we ran the 220v power cable (you can run it from 115v if your prefer) and plugged the Galaxy V transceiver in. One of the first things I heard as I tuned the band was a pileup calling a KJ6 . . . Johnston Island. That's good DX. I tuned 'er up and gave a short call and back came KH6FBJ/KJ6 with news that I had the best signal on the frequency. Hmmm, and I didn't ever talk it up over the 1 kw mark either.

The next morning around 11 am I sat back from my desk after answering all of the really urgent mail for the morning and decided to see what was coming through on 20M. Things were fairly calm except for one pileup . . . good heaven's, 9M4JY! And even more astounding . . . I am hearing him. He was just finishing up with a W3 and I could hear several big guns trying to get him to break . . . biting my lip, I waited for him to finish and then joined the pandemonium on the frequency. He came right back to me . . . name Yathe . . . Singapore . . . 5-5 . . . QSL please . . . etc. When we signed I recklessly called a CQDX . . . kind of showing off . . . and IS1ZDT gave me a 5-9 plus 20. Good grief!

What else can you say about a linear? The purpose of it is to improve your signal . . . to make you a little louder. The 2K accomplishes this. It uses a pair of 3-400Z's in parallel, tunes 80-10 meters with the flip of a switch. The blower on these tubes is the quietest I've heard yet . . . you can just barely tell that it is on. The 0-1 amp meter on the right is plate current and the left hand meter reads grid current or, with the push switch, plate voltage.

Linears can be a drag if you have to retune them every time you QSY a little bit. The 2K works over the entire twenty meter phone band for me with no retuning needed . . . J just zero in on a signal and call.

After three days of using the 2K I find that I have 35 countries worked, some of them on the rare side such as HI8, KJ6, GI, 9M4, IS, UA, VS9, 5Z4, TF, 9J2, CE1, UQ2, 7Z3, ZD8, 9L1, KS6 and CEØ. As Larry, KS6BO said, after telling me I had the loudest signal on the band, "Fellows with the Henry 2K always have outstanding signals."

. . . W2NSD/1

Drawings by Larry Howard

Gus Browning W4BPD

Gus

Part 11

While writing this second episode, Peggy and I are still up in Bhutan, with the world's nicest people.

I was on my way hitch hiking from Orlando to Philadelphia, so that I would be where there were power lines where I lived, as my father would not put in electricity at our home near Orlando. Well, I started with all of $2.50 in my pocket and to conserve my "bank roll" I was spending my nights in jail houses along the way. One of the deputies in a small town in North Carolina let me spend the night in their jail but when it came time for me to leave the next morning the deputy who let me in had gone on his annual vacation and he forgot to tell his relief about me just being a "visitor" in their jail. I called this fellow to my "cell" and asked to be let out so that I could be on my way. This jail keeper just laughed and said I would have to wait until my trial and if the judge would let me go it would be OK with him. Then he asked what had I done. I told him my story and he just laughed and said that was the best story he had ever heard; he even said he almost believed me. My trial was set for three days hence. Boy, here I was in jail for the first time in my life and for doing nothing. I asked him please to ask all the officers on the force what had I been arrested for. He did, and at the end he came to the conclusion that I was telling him the truth, so he let me out.

The jail keeper just laughed.

I proceeded on my way to Philly and finally arrived there about 11pm, and my brother who I was going to stay with was not at home and his land lady would not let me come in. (Good old Philly, the city of brotherly love!) So I just rode route 23 trolly all the rest of that night and returned to my brother's boarding house about 7am the next morning. Of course he was glad to see me and told me to go around to Philco and ask for a job with them.

Now here I was a real country boy trying to get a job, and there was a number of other people trying for the same job. The competi-

tion was very heavy with everyone trying to get into the trouble shooting department. Well, I must not have been too dumb because I got the job and about 20 fellows who took the verbal test were rejected. Now here I was doing what I really like to do. Radio work up to my ears, and plenty where it came from.

I had no radio equipment with me except a keying relay, a key, and an audio oscillator, which I proceeded to connect up for code practice. After a few weeks of nightly code practice, and saving my Rupees for some gear, I had a visitor. Can you imagine who it was? It was the Radio Inspector! He came upstairs to my room and knocked on the door and asked me if I had a radio transmiter in my room! I said no, but he said he would have to come in and see for himself. When he saw that I only had a code practice outfit he asked me to turn it on and to send my code practice for the next 5 minutes while he went next door to see if I were causing radio interference on that man's radio. I asked him who had reported me and he said Mr. ? ? ? ? ? ? next door, who was the fellow with whom I rode to work every day. (Good ole Philly, the city of brotherly love again!) I complied with his wishes and sent code on my audio oscillator for 4 or 5 minutes until he returned. I asked him if I were causing radio interference and he said no, but that my keying relay which was fastened to the wall was keeping his children awake at night. He told them this was a police complaint and not the radio inspector's business. While riding to work the next day with the complainee I asked him why didn't he tell me that I was keeping his kids awake with my code practice, and he said he didn't want to bother me with his problems! Boy, how crazy can some people get anyway?

After a few months I had my rig all fixed up, even to the receiver (yes, we built them those days) and had applied for a W3 call sign. I was given W3BBH which I used as long as I was in Philly. I even joined the Frankford Radio Club where I met old Jerry Mathis (W3BES) who used to really be the contest kid, and a real machine when he got going in a contest. I soon got a pair of 852's going with a good K.W. input and then I really started working DX. For the first time in my life I could hold my own in those little piles they used to have.

Even back in those days I started mentally to criticize the operation of DX stations, and began to think what I would do if I were in their shoes. I certainly didn't have any idea

Just a little house in the country.

that one day I would have the chance to practise what I preached. I was in Hogs Heaven: all day I worked on radios at Philco and almost all night I pounded brass, trying to work DX.

Even in those days I could hear W8CRA out in Cannonsburg working stations that no one else even called or heard. Sometimes I knew he was just pulling the gang's leg and was working a ghost just to fool everyone. Boys, don't sell Frank Lucas short; even here in Bhutan I hear him sometimes when there are no other USA stations coming through, but I think CRA has competition in the form of W5VA. When CRA fades out and skip conditions change, then I start hearing W5VA who puts out a FB signal too. Its a pity that both of these Franks (CRA and VA) are not in the same call area so that their signals could be compared with each other. An honest comparison is almost impossible, because some days conditions are not right for maybe W3 and other days for W5. They both peak about 1 hour apart. It's just about the same situation if you try to compare W6VSS with let's say W4TO: you just can't compare most of the strong boys with other strong ones from other call areas. I am still trying to figure which is best, height (W3CRA) and good ground conditions—or the sea coast (W5VA).

While working in Philadelphia I was taken out on a blind date by a friend and was introduced to a FB YL named Miss Agnes Smith. I immediately said to myself, THIS IS THE ONE! I decided to really go to work on the whole family. Their radio was in need of repairs so the next night I brought around some new tubes (probably donated by Philco!), cleaned up the volume control, really tuned it up, put up a good antenna and, boy, that old set really jumped. I was in FB with the whole family. I did not bother with asking

for dates from then on. I just said "Honey, I will see you tomorrow," and it ended up that I was over there almost every day and night. Somehow or other I just did not get on the air as much during that time; I spent nearly all my spare time with the Smiths—and Agnes. One day over at work I was asked by some fellow why I was not on the air very much and I told him about the YL QRM I was having—and he said, "Gus, why don't you marry her? Then you could get on the air again and work some of the good DX that's coming through." I thought this over and came to the conclusion that this would be a good solution to my problem. That same night I asked Agnes what she thought of us getting married, she said "Well, you are here every night anyway, so we may as well get married."

We were married a few months after that and settled down to our married life. I am sure I got the right one for a ham. Do any of you fellows know of any ham in the world whose wife would let him go on a 7 months DXpedition, then a 2 years DXpedition, fill up their house with radio gear, cover up their land with antennas? Do any of you boys have the XYL bring to the Ham Shack your breakfasts, dinners, and lunches? That's Peggy for you. She has never failed to do this for me when I ask her. I am sure I got the one and only perfect ham's wife.

I remember when we arrived in Orangeburg. We rented a small furnished room, and the old rig with the pair of 852's in push-pull was installed, taking up about half of the room. The old Zepp was put up and I was on the air with W4BPD, Orangeburg, S. C.

Finally the place where I was working for $7.00 a week went broke. Then I started this business of house to house radio service. This continued for a few years and soon I decided to rent a small place and go in business for myself with Peggy as the bookkeeper. About this time I bought myself a small lot on the outskirts of town and built a house. During those days I was a strong 160 meter fellow; even put up a ¼ wave vertical and came nearly winning a few WAS contests on 160. I was still very much interested in working real DX and the only good long-wire antenna I could get up had to cross a neighbors back yard to get to a tall pine tree. This old long-wire was good and was at just the right angle to put a good signal into Asia.

Things went very fine for a few years until that man whose lot my long-wire crossed told me one day that he did not like my antenna crossing his land. I told my wife about this calamity to my DX hamming and told her it looked like we would have to buy ourselves a farm. She said it would be OK with her. That same day I went down and opened up my shop. Daily in Orangeburg the business people take what we call a Coke break at about 10 o'clock, so down to the drug-store soda fountain meeting place I went for my Coke break. While there talking to the boys and drinking Cokes and eating Nabs, a friend of mine came in who owned a 152 acre farm about 6 miles from town. He was sort of feeling low and I asked him what was wrong and he said he needed some money. Is asked him how about selling me his farm and he said OK, mentioning a very, very good price. I said OK, I would buy it if he would sell it to me this very morning. He agreed so down to my lawyer we both went and in a matter of an hour or two the farm was mine. Back I came to my little hole in the wall and said "Honey we got ourselves a farm." She, without blinking her eyes once, said, "That sure is fine, where is it?" I told here and we closed up shop and went to see our new bought farm. (Boys, ain't that a wife for you?) We both were delighted; Peggy liked the house on the farm, and I could just picture the whole place all covered up with Rhombics, V's, Long wires, etc.

We moved in and I immediately proceeded to build a nice big ham shack on the rear of the house. This was a real Ham Shack measuring 24 ft. by 48 ft., and upstairs I even built 3 bedrooms for the children. Oh yes, Peggy and I had been busy and had 4 children by then.

I spent the next 3 or 4 months with a survey transit and Jeep laying out Rhombics. Then then next month in the cypress swamps cutting cypress poles for the antennas. 12 rhombics were laid out and finally installed. The shortest was 750 ft. from end to end. The longest 1750 ft. from end to end—on AC4-land for long path, and another on AC4 Short path that was about 1300 ft. from end to end. All antennas were terminated into Ward-Leonard Non-Inductive 750 ohm resistors. All of this antenna business was done during the War, taking about 2 years of hard work. All poles were over 66 ft. high; a few over 85 ft. high. The war was still going on so I had a few more years to kill. Then I built and built and built. By the time the war ended I had ready to go 6 transmitters, each one a K.W. input, 12 Rhombics, a 80 meter vertical, a 16 element Sterba curtain and even a few half wave doublets. I was ready to go when we were told that we could again operate.

With antennas I found that the 16 element

Sterba was just as good as a rhombic. Regarding the angle of coverage of a rhombic, I had one rhombic centered on Casa Blanca and one on Berlin. This places HZ1AB in Saudi Arabia in the exact center of these two rhombics. Both rhombics gave the exact same signal from HZ1AB. But the Sterba curtain which was centered on HZ1AB gave two S-points *increase* in signal strength. Then I put up a good rhombic on HZ1AB, making rhombic number 13 that I had in the air. I found that this number 13 rhombic gave the exact same signal from HZ1AB as the big Sterba. Some other conclusions about rhombics is that they *seem* to be terminated even when there is no terminating resistor on them. I had one rhombic centered on New Guinea—and another one pointing exactly the other way. With no terminating resistor on either one of them, the one pointing at New Guinea was always the best by at least two S-points. This was proven to me any number of other times with other rhombics. As far as tuning them up I never could see any difference whether the terminating resistor was connected or not. If I were putting up a rhombic tomorrow I would not bother terminating it. I would point it at the station I wanted to work, and that would be that. I once put up about 6 V beams which proved to be pretty good. But with V's just as much signal goes out of the back that goes out of the front! With all these antennas, plenty of power and a reasonable amount of time to hunt DX, and beating my brains out, I did manage to be number 4 in the new DXCC.

I began to study the habits of the DX stations, watching their operating hours, reading any and all DX bulletins. I began to chase DX seriously. I found out that if you want to really get a high country total that you stop all rag chewing, you only work a country until you get a QSL, you sneak home during working hours, you run high power, you have up the very best antenna your pocket book will stand and when you work that new one you go all out to get his QSL card. One of the secrets of those high country total boys is getting that QSL card.

My method was like this: First I sent a regular QSL card with a few IRCs, wait 6 weeks, then I send another QSL card and a letter and a $1.00 bill, then wait 4 weeks. Then I sent the following . . . a very nice long letter, a $5.00 bill, 10 IRCs, a batch of photos, and a home-made QSL card all filled out, with a stamp attached with Dupont Cement. All he had to do was just sign his name to the card. This last one always did the trick—that is, when you know the fellow's proper address; without that you can be stuck. Unless like I did—I found or rather ran across, FI8AA in France, he had his log, my call was in it and he gave me the QSL direct! I now know the address of AC4NC up in Sikkim and will go to work on him before I depart from this area. (At the moment, I am sitting in a hotel room in Calcutta writing this.)

I was down at my shop working one morning and a fellow stopped by to see me. He introduced himself as Frank Lucas and said his call sign was W3CRA, Frank even got married in Orangeburg and I was Best Man at his wedding! Then Frank and Vicky stayed with us for about 2 or 3 months helping me at the shop and working DX every night and morning. I remember one morning I came into the shack and Frank said he was working YI2CA. I picked up the second pair of phones and all I could hear was mostly background noise and static with a very weak signal in under the noise. I could never even make out the call sign but here was Frank copying the fellows name and address and he told me that YI2CA said that this was his first USA QSO. When Frank signed off I said, "Ah come on Frank don't pull my leg! You did not have a QSO with anyone. You are trying to kid me!" Frank said "Gus you wait and see because this fellow said he would send you an air mail QSL direct and immediately." SURE ENOUGH in about 4 or 5 days a QSL came and on it were the words Direct USA QSO! I thought I was pretty good at copying the weak ones but Frank had me beat a long ways. Evidently Frank must have built in noise and QRN filters in his ears! Oh yes, does anyone know of any other ham in the world who has 3½ inch rigid copper with gas under pressure for their feed line? That's what W3CRA is using—I have seen it—maybe that's what helps that signal of his.

While working DX and listening to some of their operating and listening to them give their name, address, power, antenna etc. I have often said to myself boy, how I wish I were on the other end. In fact I made a list of DON'TS that I would practice if I were ever DX! The list became quite long after a number of years. I had no idea that I would ever be able to benefit from that list. Here I was in a small Southern town, trying to raise 4 children, up to my ears in debt, just bearly half-way making ends meet—and thinking about a DXpedition! Boy, how crazy can a fellow be anyway? Wait until this story unfolds—the impossible finally did happen—.

. . . Gus

Robert D. Corbett W1JJL
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Torrington, Conn.

Interlaced Sync Generator for Ham TV

This unit was designed with the following points in mind: low cost, stability, simplicity, low power drain and ease of adjustment. The total cost turned out to be approximately $20 with all new parts. The unit is stable. It will hold adjustment for many weeks at a time. Power drain is a total of .455 watts, or about half what it takes to run a #47 pilot light.

The basic 31.5 kc saw-tooth oscillator employs a 2N2160 uni-junction transistor. A regular transistor will not work in this circuit.

The divider circuits are not the usual locked multivibrator or blocking oscillator type, but employ a pulse counting system known as the stairstep method. In the partial diagram (Fig. 1) resistor R1 sets the amount of voltage each pulse from the preceding stage applies to the base of transistor Q1. This varies the amount of voltage applied to CI by each pulse. Each pulse adds to the voltage applied to CI until the voltage discharge point of Q2 is reached. At this point one pulse is delivered to the input of the next counter through C2. From this it can be seen that there is little chance of any stage getting out of step. Any slight drift of the 31.5 kc oscillator will have little effect on the interlace.

Three of these dividers are used to arrive at the vertical scanning rate of 60 cps. The first divides the 31.5 kc oscillator frequency by 15. The second divides this by 7, and the third by 5. Thus a total division of 525 is provided in only three stages. The fourth and last divider takes the basic oscillator frequency and divides it by two to arrive at the horizontal scanning rate of 15,750.

A total of nine transistors, 11 resistors, 10 small capacitors and five potentiometers are used. Two small diodes are used to help shape the output pulse and remove any slight ripple that may leak through from preceding stages.

Construction of the sync generator is simple. Layout is not critical, and wiring may be point to point with most of it done with the leads of the various components. I do advise the use of sockets for the transistors though. Neatness counts only to the extent of your pride in workmanship and ease of future servicing. I have built two of these units so far, one wired conventionally and the other on a printed circuit board. No difference in operation was noted.

Adjustment

The easiest way to adjust the generator is with an oscilloscope. First connect the input of the scope to the oscillator test point (TP 1). Set the sweep rate at 15,750 cps. Adjust the

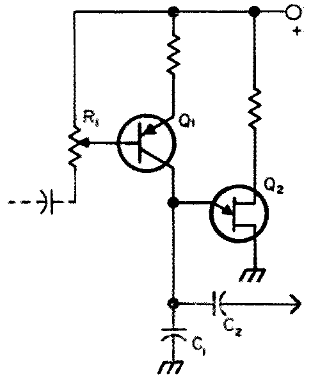


Fig. 1. Stairstep pulse converter.

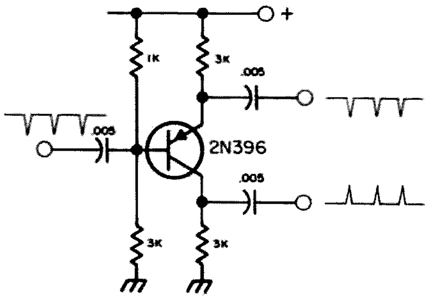


Fig. 2. Phase inverter.

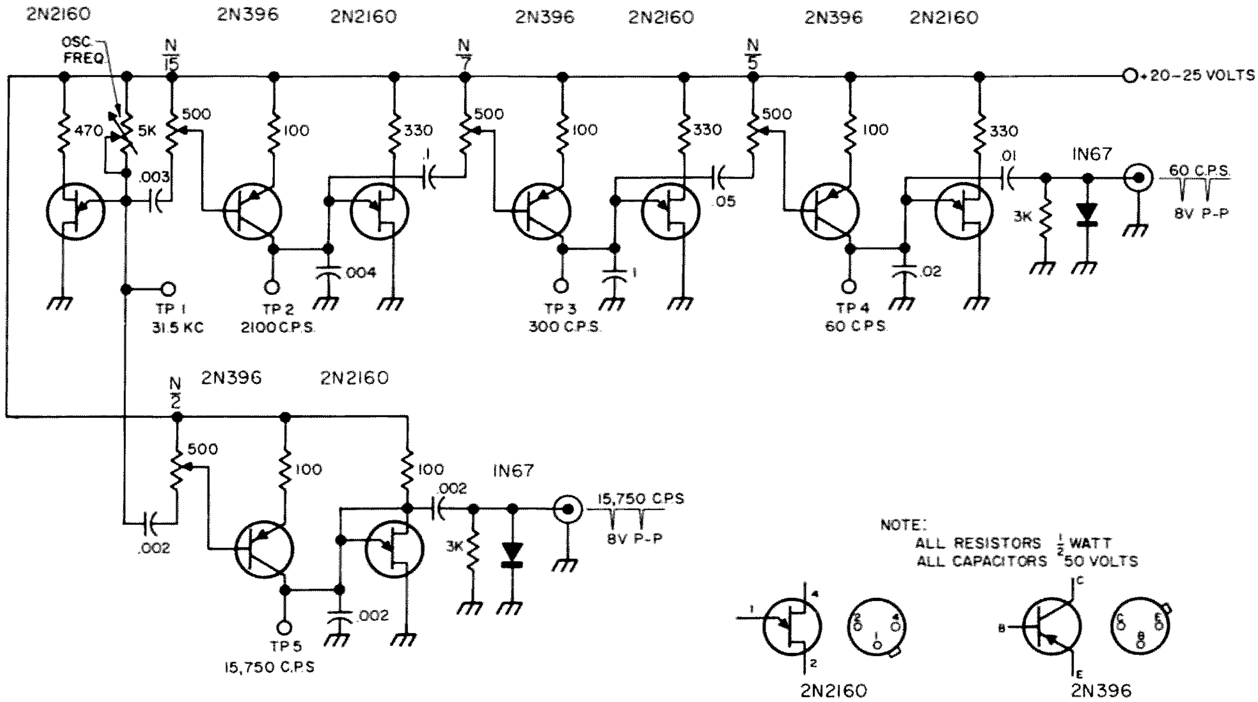


Fig. 3. Interlaced sync Generator for ham TV.

oscillator frequency control until two complete cycles are observed on the screen. This indicates that the oscillator frequency is set at 31.5 kcs. The scope input should then be connected to the test point for the first divider (TP 2) and the sweep rate adjusted to 2100 cps. Adjust the control for the first divider until 15 steps are seen. This same system is employed for the next stage with the sweep rate set at 300 cps and its control set for 7 steps as checked at TP3. Continue on to the last divider in this string with the sweep rate set at 60 cps and 5 steps. The final adjustment is to set the scope rate to 15,750 and connected to TP4. Adjust this dividers control for two steps.

With the addition of two transistors and a few parts it is possible to have both positive and negative sync pulses available. These phase inverters are shown in Fig. 2. Both are identical.

The unit performs up to expectations and has worked well at W1JJL.

. . . W1JJL

Bob Schumacher WA9AFI
1556 Juneway Terrace
Chicago, Ill.

Fixed or Mobile?

You might call us fixed, but we consider ourselves mobile. These two words, "fixed" and "mobile," as used by those special breed of "Hamoids" denote whether or not the receiver-transmitter combo is located at one specific location or whether it has the potential of getting around as in a car, boat, or plane.

But herein, the words "fixed" or "mobile" connote a further meaning to a small group of devoted traffic handlers, ragchewers, CW addicts, et al. who have one thing in common; they are all physically disabled.

The era of the so-called shut-in is gone, as today there are thousands of active amateur radio operators who for some reason or another are disabled, yet these people with their polio, blindness, cerebral palsy, arthritis, muscular dystrophy and a host of other afflictions have unshackled themselves from their "fixed" position and are "mobiling" themslves around the world by means of radio communication. Though physically tied to their iron lungs, wheelchairs, hospital beds, walkers, and crutches, these men and women, boys and girls, have found mobility in their lives. The days of loneliness, boredom, and stagnation have turned to fruitful stimulating days of adventure and creativity for these people. Emergency traffic, public assistance, DX'ing certificate hunting, or just socializing on the air has given them a new meaning in life. There are even handicap nets and clubs, such as the International Handicappers' Net and the Radio Amateur Invalid & Bedfast Club (to name two). A few of the VA hospitals are equipped with amateur radio gear and some

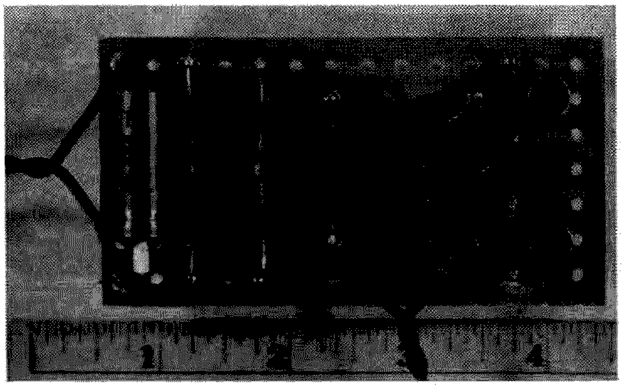
of the patients are licensed operators, while others are striving for their Novice tickets.

The hobby has become a tremendous means of combating the psychological and sociological disillusionments and embitterments of the newly disabled. Hamming indirectly helps to erase egocentric views and at the same time enlarges the individual's *Weltanschauung* (worldly views). It helps the disabled to make new friends not only in his or her community but also in all parts of the world, without even trying. Of course, it's not the panacea of all ills, but it is definitely an agreeable form of therapy (some of the medical people refer to amateur radio as a social or occupational therapy.)

How does a handicapped person get into this hobby? Mainly by studying and by contacting a ham in his or her neighborhood for guidance. Studies should consist of basic electricity and electronics. Libraries contain excellent selections. Bibliographies are available in most electronic catalogs (free for the asking, in most cases). As for guidance, the handicapped individual will be utterly amazed as to the willingness, friendliness, and cooperation his ham neighbor will offer. In fact, before he or she knows it, many other hams will be over to help. Once the amateur radio license is obtained from the F.C.C. (probably one of these same hams acted as the examiner), don't be surprised to see this same group over to help assemble the station and raise the antenna. Even if there is a loss of the use of the limbs, these ingenious part-time engineers will devise some mechanical or electrical gadget as a means for the handicapped person to operate completely and independently. Such gadgets as rubber hose with a metallic-leaf switch inside will activate or de-activate the transmitter when the disabled ham blows in the tube; or the micro-switch placed near the ham's eyebrow can open or lose the T-R relay by a simple closing of the eye; or the cooking spatula in the mouth for CW keying; or the audible tuning of the vfo by the blind operator; just to name a few of these aids. Above all, the disabled person will have made life-long friends during his orientation period and the list will grow over the years. It does take time and perseverance to get a license, but once the F.C.C. has issued you a call and permission to operate, one begins to re-live again.

Please excuse me now, as it's time for me to *Wheel* myself over to the shack as I have a "sched" with a bedfast OM and we hope to "mobile" around today.

. . . WA9AFI



A Compact DC-to-DC Converter

Honk Olson W6GXN
3780 Starr King Circle
Palo Alto, Calif.

Often it becomes desirable to include a single tube in an otherwise transistorized system for high-input-impedance, dynamic-range, or agc reasons. A case in point is in the rf front-end of a VHF mobile receiver, otherwise all transistors. It was found to be the least trouble in this receiver to use a single 6DS4 nuvistor as the first rf amplifier. This tube provided good agc characteristics, freedom from cross modulation, and low noise figure.

But supplying plate-voltage was a problem, because the commonly available converter units were for much larger power requirements. Ordinarily, the upper frequency of amateur dc to dc converters is limited by the transistor cutoff-frequency. With the less expensive germanium power transistors running at about one-fifth their cutoff-frequency, dc to dc converters sing out loudly at several kilocycles. (The "rule-of-thumb" seems to be to run the transistors at one-fifth their cutoff-frequency, so as to achieve fast rise time of the square wave.)

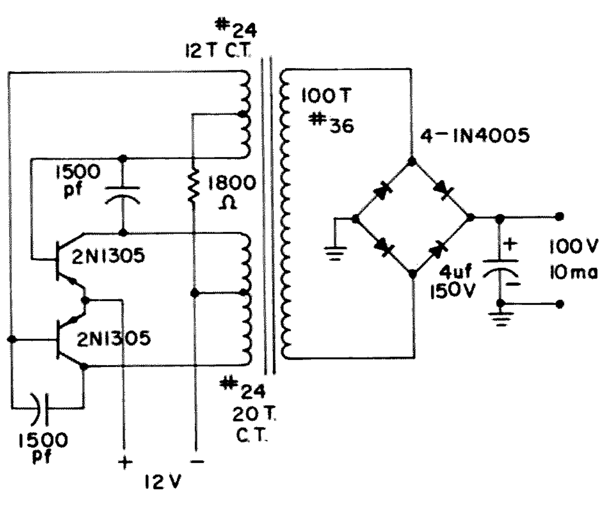


Fig. 1 Compact DC-to-DC Converter.

However, for this application we are *not* constrained to use germanium power transistors, since we wish to convert only a watt or two. For switching currents of this order there are many inexpensive germanium computer-transistors that have cutoff-frequencies of several megacycles. Now, it is the core-material that is the determining factor in limiting our frequency; and so we can almost immediately forget "C-cores" and tape-wound types. We are now in a good position to exploit the wonderful world of ferrite-cores, which will function on up into the megacycles. An additional bonus presented to us by the ferrite manufacturers is that such cores are not only available in torroid forms but in pot-core forms which are much easier to wind. The combination of pot-core form (where one simply winds a small plastic bobbin right from the wire spool, with no shuttle needed) and high frequency operation (few turns are needed), really makes this an easy job.

The converter to be described runs at about 20 kc, meaning that the job of filtering, after the rectifier, is simplified. Further, the 20 kc note, due to any magnetostriction, is above audibility and shouldn't bother anyone but the family dog. The circuit is shown in Fig. 1; note the 1500 mmfd de-spiking capacitors (yes the de-spiking capacitors get smaller too as operating frequency goes up). The unit uses 2N1305's and 1N4005's for a total semiconductor cost of about $3.50. The core with bobbin was obtained locally at a surplus electronics dealer* but a standard Indiana

* Red Johnson Electronics, 3311 Park Blvd., Palo Alto, Calif.

General pot-core such as a CF214-H could be used. The local cost with bobbin was about a dollar; which is probably the better way for an individual to buy the cores as the manufacturer and his representatives have a "$10 minimum order" policy. The circuit-board unit is shown in the photo and could be "compacted" into a few cubic inches for those with tight mobile-space requirements.

The primary windings were wound on the bobbin first although with the "completely closed" magnetic configuration of the pot-core construction it probably is not critical which winding goes on first. The secondary was then wound over the others and taped with ordinary scotch tape. The windings were all hand-wound which took only a few minutes. No winding care is necessary as the bobbin is far from being filled up. The pot-core halves are held compressed together by a 6-32 nylon screw and nut and the eight wires brought out the various holes in the core.

The unit runs about 60% efficient which isn't so great as dc to dc converters go but at this power level it is difficult (and also of small importance) to achieve more efficiency.

. . . W6GXN

Bill Roberts KØCER

Oscar Round-up

Reports from stations active during the OSCAR III experiment are beginning to drift in now. The following lists were compiled from logs submitted K4IXC, W4MNT, W8KAY, W8PT, K9AAJ, WØEYE (thanks fellows) and my own.

Active List

W1BU
HDQ
LMZ
QXX
JSM
YQI
DBT

K1LSY
K2GUG
IEJ
KJI
KJN
GUN
LMG
MWA/2
RCH
OJI
W2AZL
AMJ
LVQ
MHJ
AXU
WA2WEB
FSQ
YXS
W7PUA/2

K3KEO
W3BYF
SDZ
TDF

K5MBV
TQP
WXZ
W5AJG
NCE
UKQ
UJF
KXD
JWL
MGZ

K6HMS
HCP
DQJ
KV
GCD
TSK
W6AB
DEE
DQJ
GDO
KEV
MHS
TYM
MSG
UKQ
UXN
MGZ
WA6MNM
RLW
KLL
HTJ

JRG

K8AJF
W8FEH
NSH
YIO
KAY
PT
K9AAJ
AWP
UIF
W9CHU
PBP
ZIH
TGB
WND

KØCER
DOM
WØFNN
JRE
LER
MOX
NWX
EMS
ENC
IDY
EYE
TMO
IC
EOZ

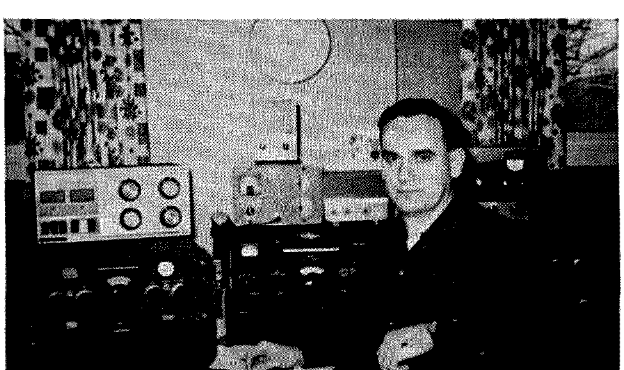
K4IXC
MHS
QIF
YYJ
W4AWS
BUZ
MNT
WNH
MVB
NEE
HHK
HJQ

SLU
WB6JZJ
JZY
KAP

K7DZG
NII
BBO
ICW
W7LHL
UAB
OUE

VE7BGZ
LU3DCA
KL7GUH
W2UK/KH6
HB9RG
DL3YBA
EA4AI
VE3BQN
DIR
6NT
7NI
BNO

Thanks to K9AAJ, W4MNT, WØEYE, K4IXC. W8PT, W8KAY



LEE Gray K9AAJ, Quincy, Illinois. Western end of first 2-way QSO through Oscar III. Photo credit KHQA-TV.

From these logs it was determined the following stations did make two-way contacts before the translator failed between orbits 206 and 214.

Worked List

Known 2-Way work was accomplished by the following stations

W1BU
W1HDQ

K2IEJ
K2MWA/2
K2GUG
WA2WEB

K4QIF
K4IXC
W4MNT
W4AWS
W4WNH

K5TQP
K5WXZ
W5KXD

W6KEV
W6TYM
W6MSG

W8FEH
W8NSH
W8KAY

K9AAJ
K9UIF

KØCER
WØIDY
WØEYE
WØNWX
WØLER

HB9RG
LU3DCA
DL3YBA

I am sure there were considerably more stations active and two-way work accomplished than these lists reflect. This, however, is what I know about at the time of this writing.

The HI and telemetry beacon became active again several days after both it and the translator quit. Several stations have reported the beacon active with a 12 second sequence. The 145.950 beacon never did function.

Additional orbital tracking data can be obtained from OSCAR Headquarters.

I understand the Project OSCAR Association and an east coast group are currently working on additional translator satellites with plans for

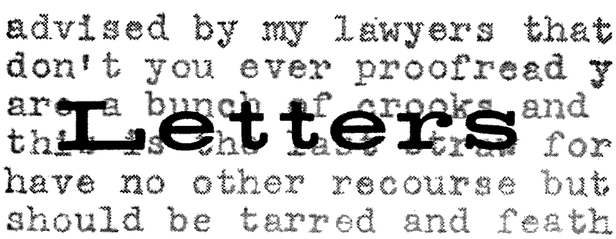
the launching of another later this year. More on this as it develops.

The general opinion seems to be that a fair amount of power, 500 watts or so, a low noise receiver and an array that could be tilted paid off for the largest share of operators. However, it is interesting to note that some stations were successful with less, both transmitting and receiving. VE7BGZ is one station for example. K9AAJ reports VE7BGZ heard him with a Rogers Majestic 5V into a BC-312 as a tunable IF and a ⅝ wave ground plane. Several other stations reported similar results using dipoles and ¼ wave ground planes. Overhead passes were much better copy on a simple dipole or ground plane than on beams, as should be expected. This is where the ability to elevate the antenna paid off.

If you have not all ready done so, please send a copy of your OSCAR III report to the Project OSCAR Association. They need as much information as possible for use in planning future satellites. And while you are at it, send me a copy also.

This summer is a good time to prepare for the proposed fall launching of another translating satellite.

. . . KØCER



Dear Wayne:

The Richmond Amateur Radio Club has decided, as a project using the club call W4ZA, to sponsor a trip to Tangier Island. This is a four and one-half by one and one-half mile island in the upper Chesapeake Bay, with a population of 900 people. For the past fifteen years there has been a recurrent problem of supplying medical care to these citizens of Virginia. We, as a club, believe that a DXpedition to this island would publicize the need of medical care, accomplishing several things, not only for these needy people, but also for the club and for amateur radio. The Virginia Council of Health and Medical Care, a voluntary, privately supported foundation that supplies doctors to rural areas of Virginia, is enthusiastic about the program and they expect to have not only local but national coverage by such publications as "Life" magazine.

We will arrive on the island on June 18, 1965, and set up our transmitters, which will be from 80 through 2 meters sideband and CW. We will operate on the 19th of June for twenty-four hours, beginning at 8 a.m. Eastern Daylight Time, and we will return to the mainland on the 20th of June. Two other doctor hams and I will be in the group of approximately eight people. Our QSL cards will be titled "Tangier-CARE; Search for a physician for Tangier Island," and we will respond 100% to all QSL's. Our project has been cleared by the Richmond Academy of Medicine, so ethically the physicians on this trip will have medical support and encouragement.

Sincerely yours,
William F. Grigg, Jr., M.D. WA4AGB

Dear Wayne,

Belated congratulations to you, 73 and your various crusades. Undoubtedly you will be up to your elbows in this one: the March 31st FCC proposals. Your fluency and wit should dish up some lively prose on the subject.

My former friends Hiram Maxim, KBW, and Ross Hull are probably whirling in their graves at the goings on with ARRL brass. I am planning a protest proposal direct to the FCC and have received (naturally) hearty approval from all the other old timers.

John Murray W1BNN
Bloomfield, Connecticut

Dear ARRL Director (I hope),

Incentive licensing is necessary and just. The new FCC proposals suit me just fine, particularly call sign license grade identification. So there!

Cordially,
Earl Henson W3ZNF
Camden, Delaware

P.S. I take all three magazines. Yours, *Mad* and *Cracked.*

Dear Wayne,

There seems to be some misunderstanding about the power rating of the 1 KW PEP Ampliler described on page 6 in the April issue of "73." The pair of 811's can run 500 watts single tone (CW) input, however, the PEP with a single tone is the same as the average power which is 500 watts—not 1KW. The PEP is twice the average power only for a two-tone signal. Unfortunately, the amplifier cannot be run to 500 watts input with a two tone signal without severe flat topping.

The plate current for voice operation should reach 100 to 150 ma on peaks depending on the meter time constant. Talking up 350 ma peaks will most certainly result in splattering and bring down the wrath of the fraternity on the operator.

Wallace B. Kincaid WB2HZG
Rochester, N. Y.

Wayne:

You and Clif K6BX represent the lunatic fringe of ham radio. Who the hell do you think you are? Your I.O.A.R. is a money making scheme for you, representing 1/3 of 1% of U. S. Hams. Nuts like you will ruin ham radio with your insinuations, half-truths—distortions, egocentric ideas.

Your editorials are written for morons—anyone can see thru them, the biggest collection of LIES—LIES ever put forth.

Our Club has checked your so-called charges about A.R.R.L.—Huntoon, etc., and find you are a damned—publicity happy liar, everything for your own gain. Out here we would put you in a nut house.

ARRL FOREVER
YOU NUT,

Yakima Ham.
Washington

Dear Mr. Green,

I wonder when the first group complained to its government that the secret to how a bird flies was being kept from them?

From what evidence is available it seems obvious that some group has relatively complete control over the gravity situation. Why don't we make a start in this direction? Perhaps in your usual (or unusual) manner you have been hinting at this. 73 has probably the greatest collection of technical talent in the world as its readers.

Here are a few of the problems not necessarily in order that could stand a little mulling:

Gravitational field oscillator (transmitter?); Oscillating gravitation field detector (receiver?); Velocity of gravitational field disturbance (faster than electromagnetic?) (Nobel Prize material here!); Resistors, capacitors, inductors, rectifiers, amplifiers, etc.; Local field control (as with electromagnetic fields at present).

To play around with these a moment, wouldn't it be funny if we found our friends in the UFOs using this system? Would amateurs be allowed "200 meters and down"? Would 73 publish data on working equipment in this area?

Bill Hounsel W5OUK
Refugio, Texas

73 HAMFEST

SUNDAY JULY 4
PETERBOROUGH, N. H.

73 is having a hamfest. It's going to be a real old fashioned hamfest with fun for all. There'll be no admission charge, no "donation" and no registration fee. Come to the beautiful Monadnock Region of New Ham Shire to meet us and have a pleasant day with all of your ham friends.

ACTIVITIES FOR ALL

Tremendous auction: Clean out all of that useless old junk. There'll be no charge and no commission. A special feature will be part of W2NSD's legendary collection for sale.

Antenna measuring contest: Prove that you can make (or buy . . .) a better antenna than everybody else. Find the true gain of your beam. Any horizontally polarized antenna for 2 or 432 that one person can hold is eligible. Have 10 feet of RG58 with a male BNC connector attached for the lead. Prizes and glory for the winner.

Homebrew contest: Bring that gear you've built and show it off. Separate judging for simple and complex equipment, gear built from 73 articles, and on neatness, originality, performance, etc. Prizes.

Two meter hidden transmitter hunt. A contest that belongs at every hamfest. Prizes for the winners.

Dealers: Surplus and other dealers with goodies for sale.

Technical talks and demonstrations by well-known hams and manufacturers.

Special bookshop sale. Unbelievable 73 subscription price. Back issue grab-bag.

73 Mountain and Pack Monadnock for fascinating VHF operation. Bring your portable and mobile gear. Open house at 73.

For the wife and kids: Nearby state parks and mountains with swimming and climbing. Antique shops. Beautiful scenery and pleasant driving. Have a picnic. Bring your food or buy some at nearby shops. Peterborough July 4th Parade and Revolutionary War program. Write to the Monadnock Region Association in Peterborough for information on inns, motels, parks, covered bridges, antique shops, tourist attractions, etc.

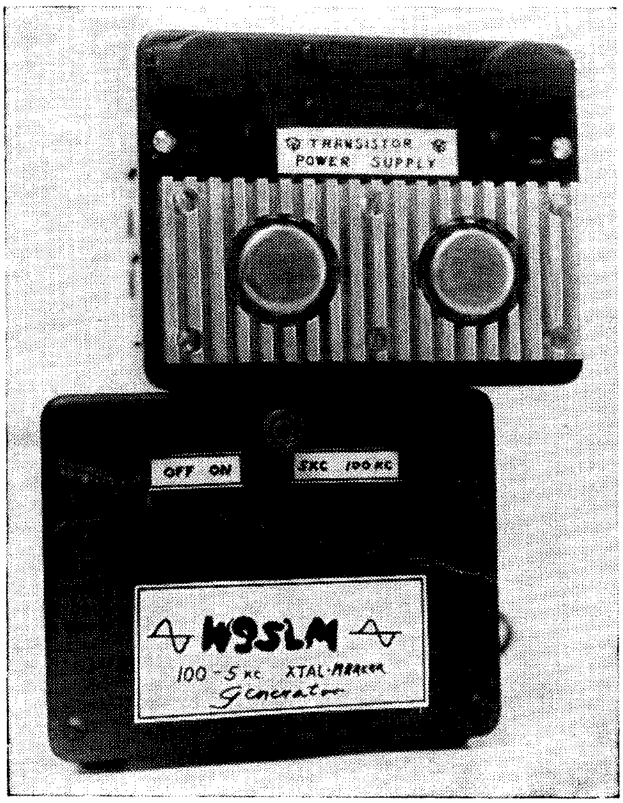
Protest meeting against docket 15928 at 3 pm.

**10 A.M. Sunday, July 4th at the National Guard Armory three blocks west of the junction of routes 101 and 202 in Peterborough, N. H.
Y'all come.**

**Let Us Know If You're Coming.
73 Magazine, Peterborough, N. H.**

Gerry Stephens W9SLM

A Surplus Sleeper



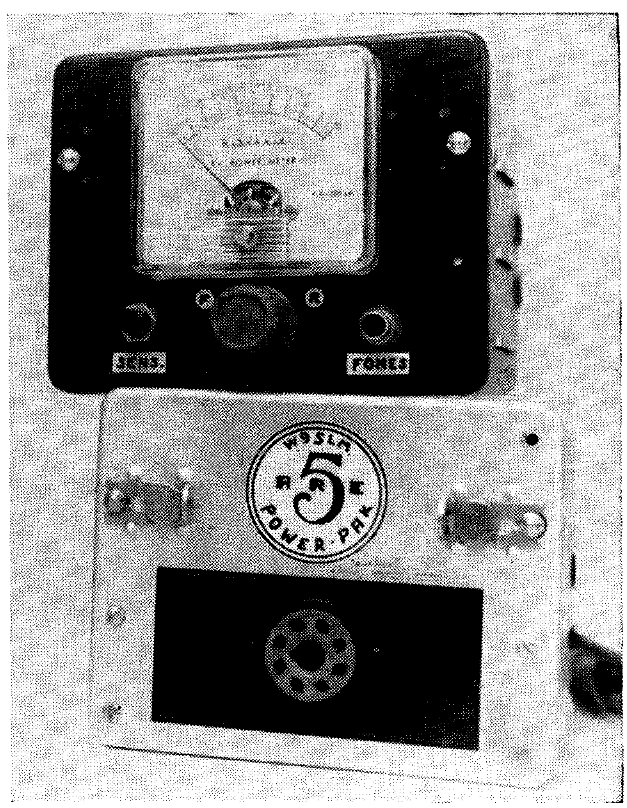
Having been addicted to "surplus" since about 1950, I have been known to dabble ("or mess around with that junk," as the XYL puts it) ever since. Many reams of paper have been written on modification and conversion of this gear to better fit the amateur needs. Like myself, many amateurs start out in the game with an ARC-5 transmitter and receiver.

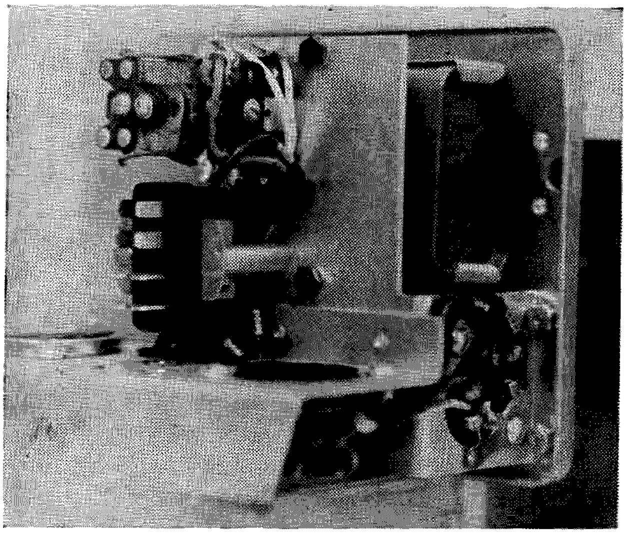
Before going any further, let me say that this is not a conversion article. Rather, it is to familiarize you with a fine piece of gear that to my knowledge has not been featured in any previous article in the trade magazines.

The Packard-Bell Preamp, Model K, contains these parts:

- 1 6SL7
- 1 28D7
- 1 6 mfd @ 50 vdc condensor
- 1 mike input transformer
- 1 output transformer
- 1 DPDT 20 to 30 vdc relay
- 1 male & female 8-pin Jones plug
- 1 octal socket
- 1 locktal socket
- 13 ½ watt resistors
- 3 ceramic capacitors
- 1 four foot length, three conductor cord, terminated with a remote type hand switch.
- 1 20" length of three conductor cord
- 1 24" length of two conductor shielded cable
- 1 aluminum chassis (with appropriate holes hi hi)
- 1 15 gauge drawn aluminum case and panel

The inside dimensions of the cabinet are 3 23/32" high, 4 23/32" wide, by 3 11/32" deep. It is extremely "clean" as surplus goes, having only 6 small holes in the front panel. These holes are for the screws that fasten the chassis to the front panel and the panel to the case. The case has louvers on the top, and both sides. The cabinet is a natural finish aluminum with rounded corners and is quite pleasing in appearance. I have not seen a similar cabinet in any of the parts suppliers catalogs, and if one was available, I would guess that the price would be considerably more than this unit.

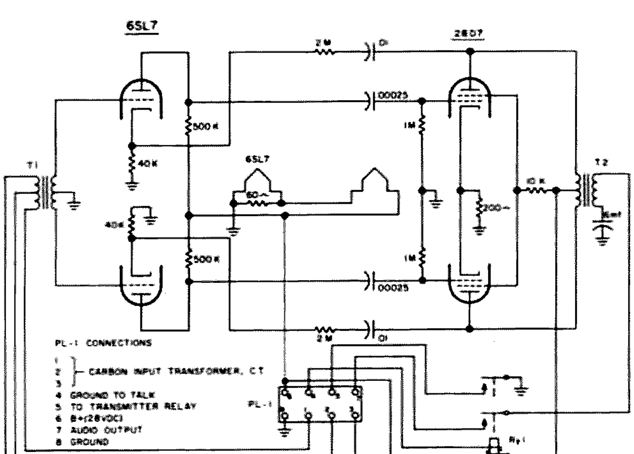




Without a doubt, this unit could be converted to a small PA amp, modulator, intercom, or other little goodie, but as I mentioned earlier, we will not deal with any specific conversion here. You build whatever you want with it. Some of the gear I have built is shown in the photos.

The schematic diagram shows the original circuit.

In case you need some ideas to fill up these little "dandy's," page through your back issues of 73. There are lots of things to construct. I have 5 or 6 more of these little units stuck away up in the attic, and I would imagine the next issue of 73 will have another Kyle special that I will want to build.



That's it fellas. I think it is a real gem even if you don't want any of the goodies tucked away inside the cabinet.

If you have trouble locating this unit in the surplus ads, try Arrow Electronics Inc., Chioago, Illinois. Their catalog number is 109AX17LT. Shipping weight is 2 lbs, and that price is $3.95 with tubes.

. . . W9SLM

photos by "Slim" Davis.

Surplus Frequencies

Ever run across some equipment with a designation but no indication of frequency coverage? Here is a list that should clear up some confusion.

Designation	Receiver range	Transmitter range	AM-FM
SCR-131	3.96-4.36	3.96-4.36	AM
SCR-161	4.37-5.10	4.37-5.10	AM
SCR-171	2.64-3.04	2.64-3.04	AM
SCR-177-A	0.4-1.0 and 1.5-4.5	0.4-0.8 and 1.5-4.5	AM
SCR-177-B	0.15-18.0	0.4-0.8 and 1.5-4.5	AM
SCR-178	2.4-3.7	2.4-3.7	AM
SCR-179	2.4-3.7	2.4-3.7	AM
SCR-188	0.4-13.0	1.5-12.5	AM
SCR-188-A	1.5-18.0	1.5-12.5	AM
SCR-193	1.5-18.0	1.5-4.5	AM
SCR-194	27.7-52.2	27.7-52.2	AM
SCR-195	52.8-65.8	52.8-65.8	AM
SCR-197	0.54-44.0 (Monitor Rec. 5-20-R)		AM
SCR-197	1.5-18.0	1.5-18.0	AM
SCR-203	2.1-3.1	2.2-3.06	AM
SCR-209	1.5-18.0	2.2-2.6	AM
SCR-210	1.5-18.0	-------	AM
SCR-245	1.5-18.0	2.0-5.25	AM
SCR-284	3.8-5.8	3.8-5.8	AM
SCR-288	2.3-6.5	3.5-6.3	AM
SCR-293	20.0-27.9	20.0-27.9	FM
SCR-294	20.0-27.9	-------	FM
SCR-298	30.0-40.0	30.0-40.0	FM
SCR-299	1.5-18.0	2.0-8.0	AM
SCR-299-F	1.5-18.0	2.0-12.0	AM
SCR-300	40.0-48.0	40.0-48.0	FM
SCR-399	1.5-18.0	2.0-18.0	AM
SCR-499	1.5-18.0	2.0-18.0	AM
SCR-506	2.0-6.0	2.0-4.5	AM
SCR-508	20.0-27.9	20.0-27.9	FM
SCR-509	20.0-27.9	20.0-27.9	FM
SCR-510	20.0-27.9	20.0-27.9	FM
SCR-511	2.0-6.0	2.0-6.0	AM
SCR-528	20.0-27.9	20.0-27.9	FM
SCR-536	3.5-6.0	3.5-6.0	AM
SCR-538	20.0-27.9	-------	FM
SCR-543	1.68-4.45	1.68-4.45	AM
SCR-593	2.0-6.0	-------	AM
SCR-608	27.0-38.9	27.0-38.9	FM
SCR-609	27.0-38.9	27.0-38.9	FM
SCR-610	27.0-38.9	27.0-38.9	FM
SCR-619	27.0-38.9	27.0-38.9	FM
SCR-624	100.0-156.0	100.0-156.0	AM
SCR-628	27.0-38.9	27.0-38.9	FM
SCR-694-AW	3.8-6.0	3.8-6.0	AM
SCR-694-C	3.8-6.5	3.8-6.5	AM
SCR-808	27.0-38.9	27.0-38.9	FM
SCR-828	27.0-38.9	27.0-38.9	FM
RC-256	100.0-156.0	-------	AM
RC-257	-------	100.0-156.0	AM
AN/CRC-3	30.0-40.0	30.0-40.0	FM
AN/TRC-1	70.0-100.0	70.0-100.0	FM
AN/TRC-3	70.0-100.0	70.0-100.0	FM
AN/TRC-4	70.0-100.0	70.0-100.0	FM
AN/TRC-8	230.0-250.0	230.0-250.0	FM
AN/TRC-11	230.0-250.0	230.0-250.0	FM
AN/TRC-12	230.0-250.0	230.0-250.0	FM
AN/VRC-1	1.5-18.0 and 100.0-156.0	3.0-62 and 100.0-156.0	AM
AN/VRC-3	40.0-48.0	40.0-48.0	FM

NOTE: Frequency ranges and type of emission are those specified in the relative TMs and TOs.

. . . WA6FTG

William C. Lewis WØCGQ
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Kitchen Heat Sink

The accelerated development of solid state electronic devices in recent years has brought their cost within range of the budget of the average amateur radio operator. The result has been not unlike hanging a carrot in front of a hungry rabbit, and those amateurs who brew their own are finding that semiconductors have a lot to offer. Many times the first try at solid state construction has resulted in the hapless experience of overheating and damaging a semiconductor or in having to trace out bugs in the gear caused by cold solder connections. The cause of these problems is either too much heat applied to the component while soldering, or, in an attempt to keep the component cool, too little heat applied to the connection. The solution to this type of dilemma is the proper use of a heat sink while soldering in a particular semiconductor.

There are a number of heat sinks on the market today which are quite effective in most applications. The main problem with these seems to be that no matter how many types you may have in your toolbox, the one you have never fits the space available. The solution to the space problem is simple and the material is available in most kitchens.

A roll of the common garden variety aluminum cooking foil will make enough heat sinks for all the solid state construction the average ham will ever do. Cut into small strips and doubled where necessary, it a makes most efficient low cost heat dissipating device.

For diodes, capacitors and other heat sensitive components with long leads, cut a piece of foil about three inches long and a half inch wide. Take one turn around the lead to be soldered with this foil strip and pull the foil tight against itself. Be sure that there is a good tight physical contact between the foil strip and the lead. Leave the ends of the foil strip out away from the lead to act as radiators. When soldering a connection to a lead of a component with the foil attached, most of the heat normally radiated by the component itself will be dissipated by the foil strip.

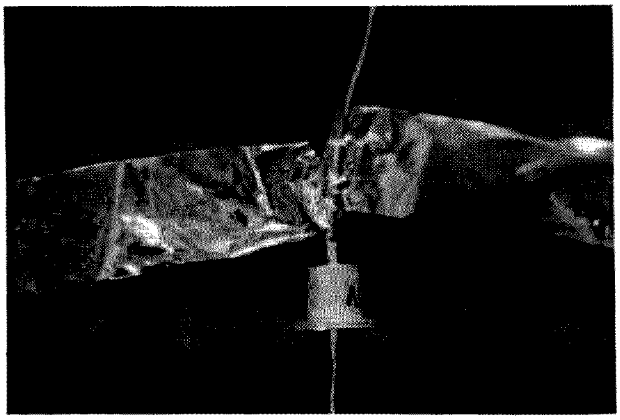
When placing transistors in equipment, wrap a strip of foil around the body of the device to help keep the case temperature down during installation. This also would be a good idea if you found yourself running semiconductors near or slightly above ratings in experimental equipment. Always remember to keep the ends of the foil strips free to radiate heat to the surrounding air.

If you care to test the heat dissipating ability of this arrangement, wrap a piece of foil around a two inch piece of component lead in the manner explained above. Hold one end of the wire and apply a preheated 250 watt soldering iron to the other end. Although in time you will burn your fingers, you will find that even with this excessive amount of heat applied to the wire, it will take a fair amount of time for the wire to become so hot that you will have to drop it. I realize that this test is rather extreme and I certainly don't advocate the use of 250 watt soldering equipment in any semicondutor circuit work.

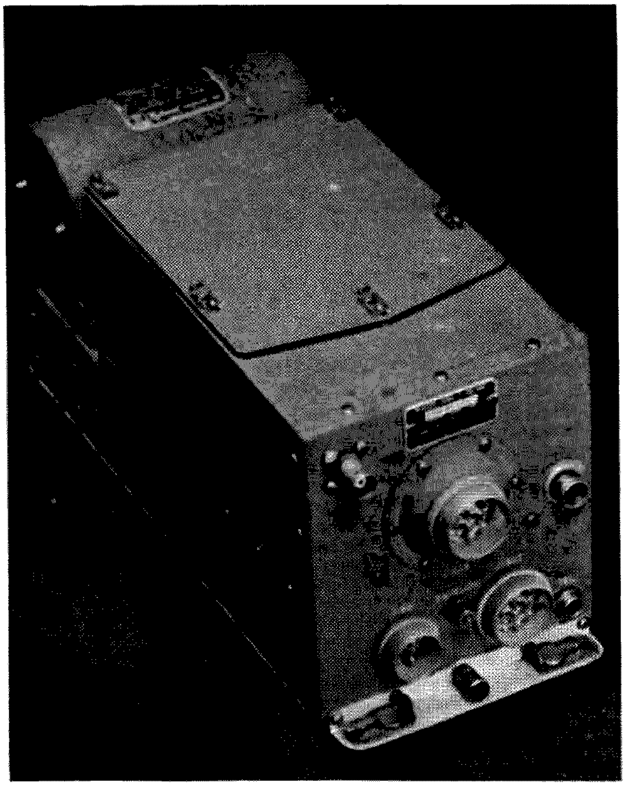
Although strong enough to be used well as heat sink material, foil can also be removed from tight corners quite easily as it will tear loose from a circuit board without component damage. I have installed it between a component and a circuit board to dissipate heat from a large area and when finished soldering in that area, I simply tore it away from the entire assembly. Folded into layers, it can be used as makeshift power transistor heat sinks.

There are many places where the heat dissipating properties of aluminum foil can be used to great advantage in the ham shack. Try it and see.

. . . WØCGQ



The Kitchen Heat Sink.



Roy Pafenberg W4WKM
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Fairfax, Virginia

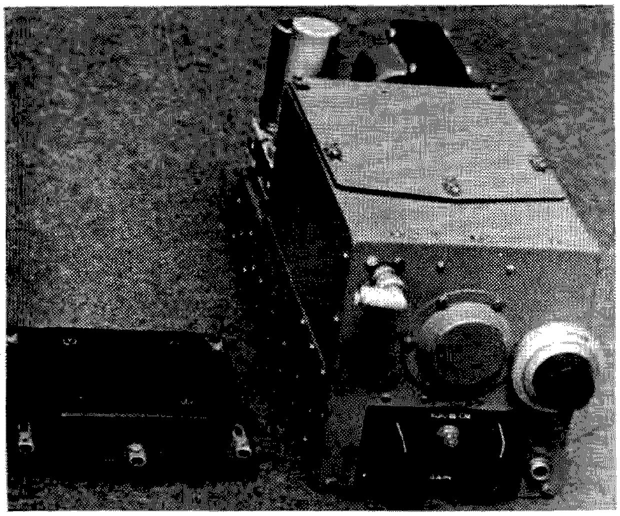
Converting the R-508/ARC

This later day VHF Command Set Receiver requires only minor modification for superior 2 meter performance.

The R-508/ARC receiver is the 28 volt, military nomenclatured version of the Aircraft Radio Corporation R-19. The R-507/ARC is identical except that it is designed for operation from a 14 volt dc supply. Both resemble the older Command Set receivers except that no dial is provided and all connectors are mounted on the front panel. Frequency coverage is 118 to 148 mc in one continuous tuning band. A total of 9 tubes are used in a modern superheterodyne circuit which features 2 rf and 3 *if* stages, AGC, noise limiter, adjustable squelch and 2 stages of audio. Audio output is rated at 360 mw into a 300 ohm load. Sensitivity is better than 2 microvolts for 10 mw audio output and selectivity is 175 kc at 60 db down.

All that is required to convert these receivers to home station two meter use is to add a power supply, rf gain control, audio gain control and speaker. This conversion uses the power supply described in the earlier article (Sept. '63) and the description will not be duplicated here. This supply is constructed on the dynamotor mounting base and the filament, plate and ground terminals on the connector are unchanged. Remove the bottom plate from the receiver and set aside along with the hardware. Remove the mounting nuts from the three front panel power connectors, J-301, J-302 and J-303. Clip the red lead attached to Pin A of J-303 and pull through the wiring to where it terminates on C-331. Unsolder and discard the lead. Clip the red lead attached to Pin E of J-303 and pull through the chassis hole. Neatly dress this lead from where it terminates on C-343 to the terminal on C-331 from which the other red lead was removed and solder this connection. This step removes B+ from the power connectors and routes the B+ directly from Pin 3 of the dynamotor connector to the receiver plate circuits.

Clip out and discard the white lead running between Pin D of J-303 and Pin D of J-302. Clip the other white lead attached to pin D of J-302 and pull through the chassis to where this lead terminates on a terminal of L-310. Unsolder and discard this lead. Locate the white lead which runs from Pin 2 of the dynamotor connector to one terminal of C-334. Unsolder this lead from C-334 and solder to the now vacant terminal of L-310. Clip and discard the white lead running between Pin A of J-301 and Pin F of J-302. These steps remove the filament circuits from the front panel connectors and connects them directly to Pin 2 of the dynamotor connector.



Converted receiver.

Clip from Pin B of J-301 the black lead which runs to C-331. Dress this lead out of the way for future ground connection. Clip from Pin C of J-302 the black lead which runs to Pin B of J-301. Discard this lead along with J-301 and C-301. Unsolder from Pin C of J-302 the black lead which runs to R-351, the squelch control, and dress the lead out of the way for future ground connection. Unsolder the two black leads and the sensitivity control ceramic bypass capacitor from the ground lug of the phone jack. Clip these leads from where they terminate on Pin C of J-302 and Pin C of J-303, discarding leads. Clip the green lead and bypass capacitor from Pin E of J-302, discarding the capacitor and dressing the green lead aside for future connection to the rf gain control. Unsolder from the the phone jack the two brown leads which run to Pin A of J-302 and Pin B of J-303. Clip these leads from the connectors and discard along with J-303. Clip the green lead from Pin B of J-302, discarding J-302. Clip but do not solder this green lead to the now vacant ground lug of the phone jack.

Remove the receiver mounting angle from the bottom front of the receiver, discarding the angle and retaining the mounting screws. Loosen the squelch control and fold back out of the way. Cut a 1⅞" x 3⅛" rectangle of sheet aluminum stock. Place the plate over the bottom of the front panel and scribe the location of the squelch control, the former mounting angle mounting holes and the two bottom connectors. Symetrically locate two ⅜" holes to fall within the area of the ex-connector holes for installation of the audio and rf gain controls. Drill all holes in the plate, deburr the holes and apply a couple of coats of spray lacquer. Mount the plate, using the former mounting angle screws and the squelch control to hold it in place.

Mount a 50,000 ohm, 2 watt potentiometer in the left hand clearance hole and a 1 megohm, audio taper control in the right hand clearance hole. Terminate the two free black leads running to C-331 and R-351 on the ground terminal of the audio gain control. Run a lead from this point to the ground terminal of the rf gain control and hence to the ground lug of the phone jack, soldering all connections. Solder the green lead formerly removed from Pin E of J-302 to the other terminal of the rf gain control. Remove R-347, the audio output stage grid resistor, and wire the audio gain control using shielded lead with the center connector going to Pin 5 of V-309 and the top going to C-363. Ground the bottom. Install knobs on the new controls and decals as desired.

Either phones or an external speaker with a 300 ohm matching transformer may be patched into the phone jack. Alternatively a speaker may be used. The technique is shown in the photographs of the Command Set top cover.

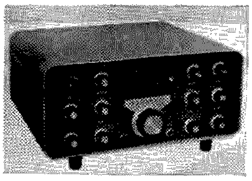
Provision of a suitable dial is the sole remaining problem. The dial used will depend primarily on what is available. The unit shown in the photographs is a Beckman type RB turns counting Duodial coupled to the usual Command Set splined tuning shaft extension. While the 15 turn dial does not provide coverage of the full tuning range, it is fully adequate for 2 meter use. Probably the best method would be to secure the complete dial drive assembly from a defunct Command Set receiver and mount this drive in the same fashion that was originally used. This would require removal of the rf subassembly and drilling of the capacitor frame to mount the gears. In this event, the extruded aluminum connector mounting, which is shown in the photograph with a snap hole plug installed, would be removed and the regular Command Set dial installed. The old markings could be covered with a couple of coats of spray lacquer and the new scale made up with commercial decals.

This completes the basic conversion and we are now ready for the smoke test. Use of the plug-in power supply described in the low frequency receiver article is strongly urged. If an external supply is used, the connections should be terminated to the former dynamotor connector. Connect 28 volts ac to Pin 2, 250 volts dc to Pin 3 and the common lead to Pin 1. Advance the squelch, rf gain and audio

New Products

Telco No-Tune Linear

Telco introduced a new model at the Swampscott Convention that is generating a lot of interest. It's a 2 kw pep linear for 2-30 mc that requires no tuning or band switching. Price is $695. They also make one for six. Get more information from Telco, 575 Technology Square, Cambridge, Massachusetts. Tell them who sent you.



Heath 6 m SSB Transceiver

Heathkit has announced a new six meter sideband transceiver that should be of considerable interest. It covers 50 to 52 mc with upper and lower sidebands, CW, ALC, etc. Power input is 150 watts PEP. Price is $325. Heath Company, Dept. 73, Benton Harbor, Michigan. Available in July.

Call Letter Signs

The Gift Shop seems to be getting a corner on the call sign market. Thir newest item is a sign with your call letter two inches high. It makes a nice item for your desk or shack. $1.50 pp. from the Gift Shop, Box 73(!), Northfield,

Galaxy 6-2 SSB Transceiver

Galaxy is about to bring out a transceiver for 6 and 2 that will have about every feature that you can imagine. Tentative specs call for 100 watts pep of SSB, 100 watts cw and 30 watts of AM. It's transistorized except for three tubes in the transmitter. It covers all of 6 and 2 plus CAP, MARS, and then some, with 10 kc receiver incremental tuning. It includes audio notch filter, audio compressor, crystal-controlled transmitting (if desired), etc. In short, look carefully for this transceiver; the price is going to be very good, too. Write to Galaxy Electronics, 10 South 34th Street, Council Bluffs, Iowa.

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gain controls; connect power and an antenna and you are in business.

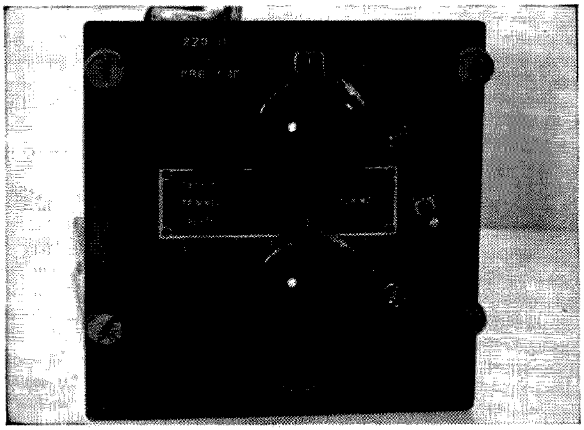
Other conversions are possible. The 12 volt model, installed with the original cables and control head, would make an ideal mobile installation, with no conversion of any kind required. Although performance of the converted receiver is good, a slight deficiency of audio gain may be noted if a speaker is used. Decreasing the value of R-343, the squelch limit resistor will greatly increase the audio output, although squelch operation will be impaired. One very practical solution is to not install the audio gain control and to replace R-343 and the existing squelch control, R-351, with a single 50,000 ohm control. The lower resistance end of this control will provide increased audio gain as required while the higher resistance end of the control provides normal squelch adjustment.

Excellent performance and ease of conversion make this receiver an easy method of obtaining 2 meter reception. Keep your eyes open and shop around. These later day Command Set equipments are very much improved over their prototypes and are well worth a premium in price.

. . . W4WKM

Note: a full schematic of the R-508/ARC is available from 73 for 50c.

Leroy May W5AJG
9428 Hobart St.
Dallas 75218, Texas

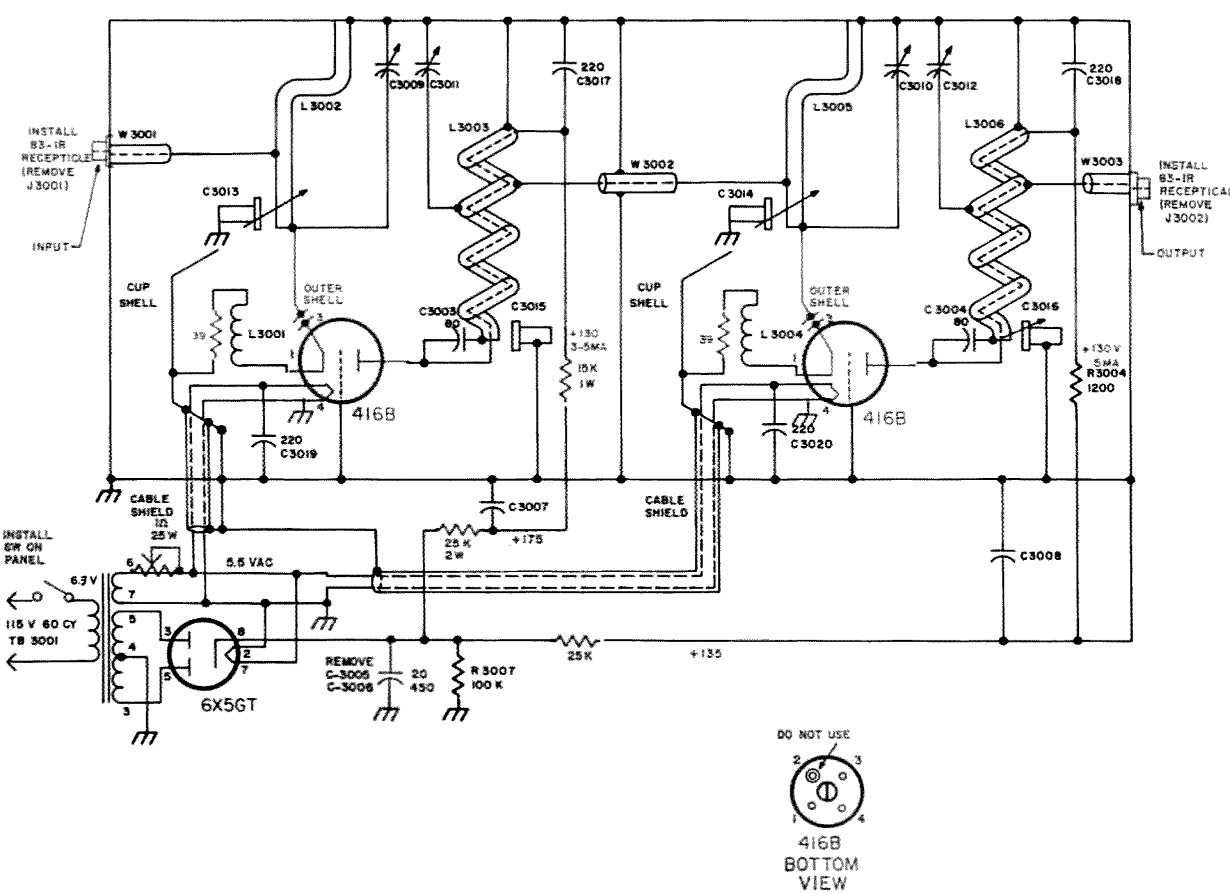


Photos by Jim Dungan, Dallas

Converting the CG-50ABM

Using the 416B on 220 mc

In 73 Magazine for June 1964, details were given for converting the Navy type CFN-416B planar triode tube in place of the original 446A or 2C40 types. Since this conversion resulted in a very worthwhile improvement in the equipment, it was thought advantageous to apply the same treatment to a somewhat similar piece of gear, now reposing in the attic this time covering the range of 220 mc instead of the 432 mc assignment.



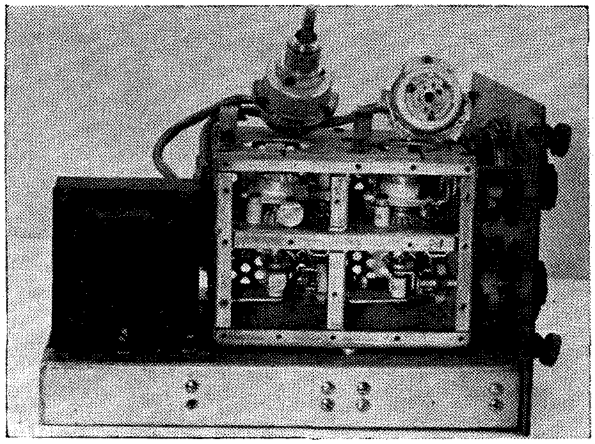
Conversion of CG-50ABM. Modifications are in red.

The Navy Type CG-50ABM (or the 602-A1, or the BC1284) Preamplifier built by the General Electric Company, consists of a two-stage tuned radio frequency amplifier originally using the 446 series lighthouse tubes, and covers the frequency range from 175 to 230 mc. It was originally used to beef up the efficiency of the SCR-602 Radar set. Available in surplus as early as 1946, the CG-50ABM was converted to 144 mc use as well as being used on 220 mc (See *CQ* magazine for March 1947). The 446 type tube was the top performer in those days, as far as N/F and gain at 220 mc and up. When better tubes became available for 144 mc, this set was pushed aside a bit, and until the 416B became generally available to the 220 mc man, the CG-50ABM continued to see service on the 220 mc band. It will now be adapted to this 416B and as such will become a pretty good item at these frequencies. No changes will be required to tune the 220-225 mc assignment except to substitute the newer planar triode tubes for the originally installed type. A built-in 115 vac source is included and makes this box ideal for the job. The pre-amplifier is the "grounded-grid" type using flat-plate inductors and variable capacitance tuning elements, which of course eliminates any neutralizing problems, even though triodes are being used. Since the 446 type lighthouse tube is of a different total length physically from the 416B tube a little improvising will be necessary to make the tube fit in the original socket.

Once the tube mounting problem is solved, then the electrode voltages will have to be slightly modified. This is easily done by changing the values of a couple of resistors and full details will be shown by referring to the modified schematic. A couple of photographs will also help in the description. By lowering electrode voltages a bit on the 416B's, we eliminate the necessity of blowing air on the seals of the tubes. This has all been covered in the aforementioned mentioned article as well as the method of testing after the conversion is completed. Please refer to this article as some of the more practical pertinent points concerned will not be recounted here.

Modifications

The first order of business is the physical mounting of the new 416B tubes. Since both stages are identical in construction, the description to follow will refer to one tube only. Merely repeat the work for the second tube.



Side view of preamplifier.

Referring to the left side view photo of the completed unit with one of the sides off the rf box, it may be seen that the cathode connector portion of the original socket has been inverted on the socket stand-off insulators. This will allow the cathode shell of the 416B to snugly fit in the spring brass silver plated fingers. Now the circular grid-connector disc of material carrying the fingers to ground the 446 type tube is bent upwards a bit and will now engage the grid portion of the 416B, effectively grounding this tube also.

The only thing now remaining is to extend the plate connection of the 416B to fit into the fingers that formerly engaged the 446 plate. This is done just like the previously related arrangement in the 432 mc receiver article. A piece of ¼ inch copper tubing approximately ⅝ inch long is slit at one end and slips over the plate connection of the 416B. The other end of the tubing will now fit into the plate connector assembly of the socket.

Now that the tube is mounted, the tube socket case, above deck, containing the octal socket and other component parts of the 446 tube will be removed and this assembly will be modified by mounting a standard 416B socket. A new cathode resistor of 39 ohms will be installed therein as well as the original rf choke and by-pass capacitor. The exact way these few parts are mounted within the shell is of no great importance.

In summary then, the following parts are to be changed out or modified;

Cathode resistors R-3001 and R-3002, to be changed to a value of 39 ohms.
Resistors R-3005 and R-3006 to be changed to a value of 25K.
Resistor R-3003 changed to a value of 15K

The above new values installed in the B plus line will place the correct voltage of 130 volts on the 416B tube plates.

Further proceed;

Remove filter capacitors C-3005 and C-unit (electrolytic). Actually it is not strictly necessary to remove these capacitors, but it will be much easier to service the unit later on if they are eliminated and something more compact mounted under the chassis used, such as the electrolytic.

In order to drop the heater voltage from 6.3 vac to approximately 5.5 vac, install a 25 watt, 1 ohm variable resistor. Adjust for proper voltage. Also for convenience, install an off-on toggle switch on the front panel to take care of the 115v ac. The original equipment performed this function at some other point in the receiving system.

It will also be wise to provide a few ventilating holes in the two sides of the rf box to allow circulation of air to the 416B's.

The last item will be to change out the "odd-ball" rf input and output connectors that come on the CG-50ABM. If you should have mating plugs for these connectors, fine—but

if you don't, these may be replaced with ordinary 83-1R receptacles to fit conventional PL-259 coax plugs.

Tuning Up

Due to the increased input capacitance of the 416B tube, it will be noted that the cathode tuning capacitors will tend to mesh with less effective capacity in the circuit, but the 220-225 mc band is amply covered. Unlike the 432 mc job previously discussed in the *73* article, this one will actually tune in the cathode circuits, due to the lower frequency involved and a bit less effective loading exhibited. On this lower frequency of 220 mc, a pretty good preliminary tune job can be done by peaking up on outside ignition noise (not tube noise). Turn off the ANL of the receiver *if* strip being used and adjust all front panel tuning controls as well as the trimmers C-3014 and C-3016 on the left of the CG-50ABM box.

Nothing was gained at this frequency on this unit by tapping in the antenna closer to the 416B cathode point than the original "tapped-down" location. As for results on 220 mc, a distinct improvement will be noted in the S/N department with the 416B's as compared to the 446A's. Other than that, it will depend on just how good your present 220 mc converter is when used alone. A rather remarkable improvement of from 6 to 10 db in S/N ratio, as well as a gain of from 16 to 20 db may be shown if the associated 220 mc converter is just so-so, or perhaps possesses a rather poor noise figure. However, if one is using a converter with a good rated input tube at this frequency and the overall operation of the unit is quite good as to N/F, then of course, the two stage 416B preamplifier will not show such spectacular results.

Regardless, even under such conditions as these, the additional gain and added selectivity will certainly be present to a greater degree than formerly. If the existing converter is a broad-band device, peaking the pre-amplifier tuning as one moves a half megacycle or so across the band, will now be necessary.

In some locations around the country, operation at 220 mc brings with it converter problems associated with spurious beat TV-FM type signals, in which case the additional selectivity afforded by the tuned 416B preamplifier should prove very useful.

At any rate, after using such modified gear with 416B tubes, vhf-uhf operators will have something to compare against when the step to parametric amplifiers is taken.

. . . W5AJG

Roger Smith K4PFK

High Power with an ART-13

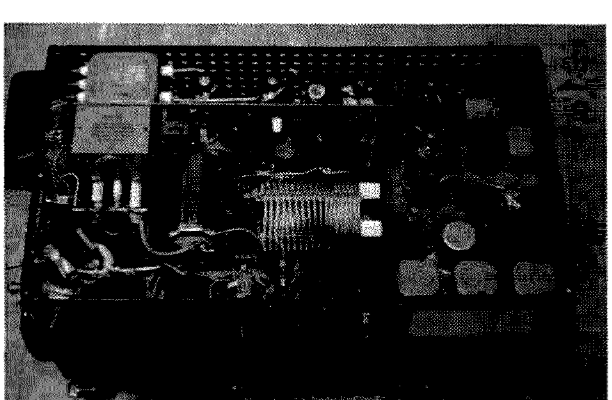
As most surplus-minded amateurs know, the ART-13 (and its Naval counterpart, the ATC) is a Collins autotune transmitter designed for operation mainly between 2 and 18.1 mc. In service, they drew their power from a 28 volt dynamotor which produced DC voltages of 450, 750, and 1150. The medium voltage was used on the 813 and 811's at high altitude while the highest one was used at altitudes less than 25,000 feet. The most amazing feature about this transmitter is the 11 channel autotune system. You may preset all of the 11 channels anywhere within the transmitter's frequency spectrum. The autotune motor derived its power from the same 28 volt battery that ran the dynamotor. About 25 seconds are required for the transmitter to switch a channel.

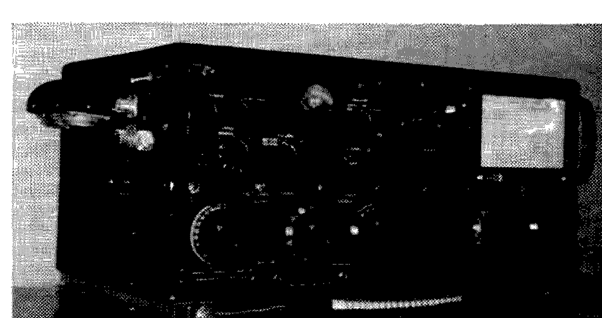
The ART-13 sells for between $40 to $80 depending on where you get it and its condition. Most of the conversion articles that I have read concerning this unit are for putting it on the air in a more or less original condition with little done to the rig other than constructing a power supply for about 200 watts input or so. I ran my ART-13 for 6 months at this power before deciding to soup it up to half a gallon.

As a general rule, the 28 volt supply is usually the most difficult of the several supplies to build, due to the trouble encountered in locating parts. This supply should be capable of at least 10 amperes. The transformer that I employed is rated at 12 amperes with a full secondary voltage of 36. There is a drop of about 10 volts through the rectifiers, so if you want the full 28 VDC, you will have to have a transformer with a 38 volt secondary. Anything from 24 to 28 VDC is sufficient to run the transmitter. About the only difference that I observed between the two voltages was the speed at which the autotune system operated. The rectifiers are hooked up in a bridge circuit, using the entire secondary. The filter choke should have very low resistance. The filter capacitor should be rated at a minimum of 50 volts and have a capacitance of about 2000 μf.

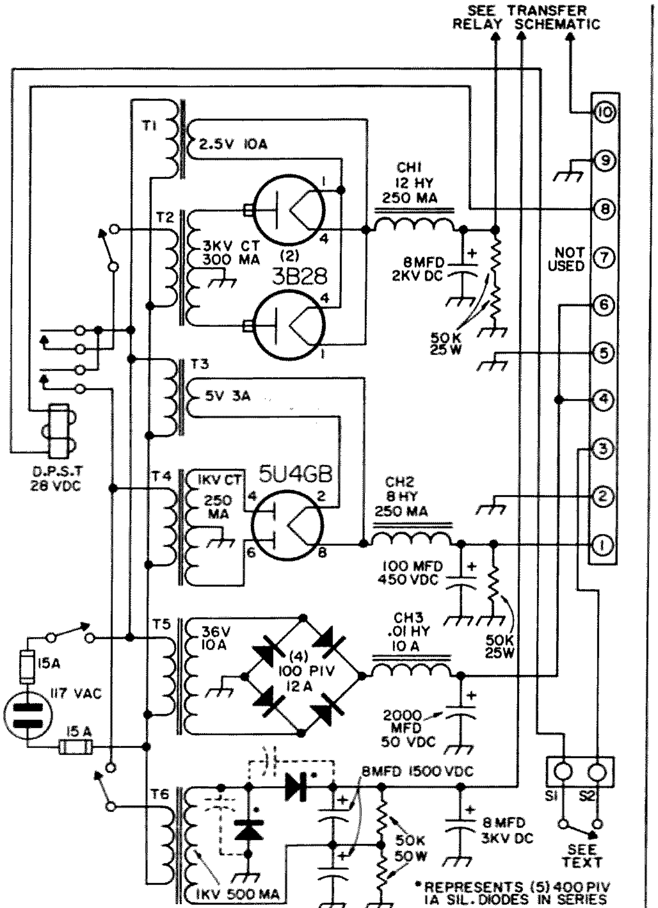
The 450 volt supply is required to run the audio amplifier tubes, buffers, crystal calibrator tubes as well as the oscillator. It is imperative that this supply have good regulation. If not, the rig will chirp on CW. A filter capacitor of at least 100 μf should be used in this supply. A single 5U4 withstands the load very well. I have been using the same tube in my supply for over a year without a failure.

The 1500 volt supply employs a pair of 3B28 xenon rectifiers in a conventional full wave circuit. 866A tubes may be substituted but the 3B28 is much more reliable and will





Left: Inside view of converted ART-13. Above: panel view.



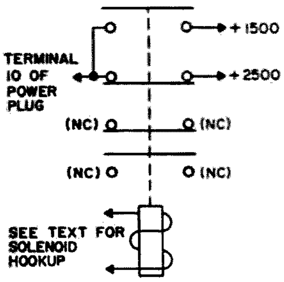
Power supply for high power ART-13.

require no "running in" if you move the tube. High regulation is not too important with this supply since the load is almost constant. It is used on phone only. About 8 μf should be sufficient to filter this supply.

The 2500 volt supply is a full wave voltage doubler circuit employing a total of ten 400 piv, 1 ampere silicon diodes. The transformer for this supply should have a secondary voltage of about 1000. This will result in a DC output of about 2500 or so. It should be filtered by at least 8 μf across the entire supply. The doublers should also be rated about 8 μf apiece at voltage of about 1500 since they are in series. Voltage transients might develop across these diodes; it would be good to connect a .001 μf capacitor across each of the rectifiers.

At this time, you might be wondering why I built two separate supplies for the two high voltages instead of getting both voltages from one. When I first went on the air with the rig, I had no intention of going high power. When I finally decided to, I didn't want to tear up what I had already put together so I just built the doubler on another chassis and wired it in with the main supply.

The modulation transformer is rated at a



Transfer relay in un-energized position.

test voltage of 4000 and would probably withstand 2500, but the two 811s certainly will not. Therefore, it would not be advisable to run above 1500 volts when you are on phone. The average power input on phone is about 200 watts. Highest power will be obtainable on 80 meters, with slightly less on 40 and 20 meters.

I added a third meter in the dummy low frequency oscillator panel. This panel contains a 28 ohm filament resistor to act as a substitute for the 1625 used as the L. F. oscillator tube. If your ART-13 happens to have a L. F. oscillator unit instead of the panel, you may discard it, because it is of no use to the amateur. A dummy panel may be obtained from most of the places selling ART-13s. The additional meter has a range of 0-500 ma and is for measuring both plate and modulator current. A meter of less than 500 ma is not recommended because it might be damaged by the modulation peaks reached on phone. I broke the high voltage line at the modulation transformer to insert the meter, although it may be placed anywhere that is convenient and accessible to the operator. Disregard the P.A. Plate position of the multimeter, because it is not operative in that position. It is advisable to remove the porcelain bowl off the left side of the transmitter and replace it with another piece of aluminum so you can mount two coaxial fittings for transmitter and receiver antenna.

I added a new tank coil for use on the eighty meter band because of the high power. The variometer itself is sufficient for 40 and 20 meters. In order to mount this new coil it will be necessary to remove the low frequency antenna relay, K-105. It serves no purpose for the amateur in its present position, but it should be saved for use as a high voltage change-over relay for the 1500 and 2500 volts supplies. The new coil is the Air Dux Model PI #195-1 good for 500 watts. The original coil is left inside although it is not used for anything except support for the left end of the new coil. The right end is supported by two porcelain insulators which were fastened to the perforated side panel. The four-turn ten meter section, along with the plastic board, is removed before mounting.

When you first apply 28 volt to the rig and key it for a time or two, you will notice that the keying relay is rather loud. This noise discourages most hams from operating CW with this rig. It may be reduced or even cured by connecting a 50 volt electrolytic capacitor with a rating of somewhere between 50 and 100 μf from the test key switch to ground. This will reduce that loud clank to a weak click.

In its original condition, the transmitter employs an L-Net output circuit on 80 meters. This is not very good as far as harmonic suppression is concerned, so it was deemed best to convert it over to a Pi-Tank. In the October '63 issue of *QST*, there is an article on converting an ART-13 to SSB. The author also describes an output tank conversion in his text. I used that output tank conversion in my rig and found that it works very satisfactorily. Everything is still automatic so the autotune system remains intact and operative. I will not go into the details of the conversion here, but advise you to read this article, for the author gives a very accurate description of how to perform the operation.

On some of the transmitters a readjustment of the keying relay will be in order due to age and wear. The relay contacts are easily accessible from the top. However, if the relay is too slow for you on CW, you can speed it up a bit by loosening the spring in the bottom of the relay. The whole assembly must be removed for doing this. It is done by removing the connecting wires to the vacuum switch, taking off the Jones plug, and removing the screw in front of the modulation transformer. The relay may be keyed either with a straight key or an electronic keyer. A bug is not recommended, because the dits will have a somewhat ragged sound if one is used.

There may be some confusion as to what S_1 and S_2 are on the schematic. This is a switch that I mounted in the hole left vacant by the receiver terminal after it was removed. The new switch may be mounted in any position that is convenient to the operator. The purpose of this switch is to energize a 28 volt relay feeding primary voltage to the plate transformers. This relay should have very heavy contacts since it must withstand the full load surge on phone. The switch is wired in series with lead #3 of the power cable. I recommend breaking the line inside the transmitter rather than outside. Remove the side hood from the unit to reach the connector terminal. This switch will turn on the 450 volt supply. Both the 1500 and 2500 volt supplies have their

own separate switches farther on down the primary line so you can run the 450 alone with the others off.

As I mentioned earlier, the low frequency change-over relay (K-105) is removed. It may be used as a high voltage transfer relay for the 1500 and 2500 volt supplies. If this is desired, the transfer will be done automatically when you throw the mode switch from VOICE to CW. To accomplish this, run one side of the relay primary to a 28 volt source inside the transmitter (in my case, I tied it to the hot side of the switch that turns on the 28 volt relay delivering power to the plate transformers). The other side is to be connected to the second terminal from the bottom, on the left side, back wafer, or the mode switch. If most of your operation is CW, I might advise you to wire the two high voltages as shown in the diagram. However if most of your operation is on phone, reverse the two wires. But if you spend about equal amounts of time on both modes, either way is fine. The reason for this is so that the relay will not have to be on any more than is necessary.

To go back over a few miscellaneous items, it will be necessary for you to purchase a plug to fit the power receptacle on the transmitter. It is designated type U7/U and is available from Fair Radio in Lima, Ohio.

Due to the excessive plate voltage being used on CW, a small bit of idling current will be drawn by the 813 in the neighborhood of 10 or 20 ma. This will count against your tube dissipation capability, so it might be advisable to build a bias supply and connect it through a pot to the grid of the final. This has not been included on the schematic.

In regard to the efficiency of the transmitter, I have made several tests with an accurate wattmeter. With an input of 500 watts, it was putting out approximately 380 watts which is 75%. This measurement was made on 80 neters. Power output will be slightly less on 10 and 20 meters due to the lesser amount of lrive available on these frequencies.

The VFO will really amaze you with its tability and calibrating accuracy. Even though t is over twenty years old, it outperforms nany VFO units made commercially today.

The total cost of converting the ART-13 vill vary with the individual's own supply of arts and what he has to buy. Therefore, I hall not try to make an estimate here. But vhen you get through, I guarantee that you vill have a transmitter to be proud of and one hat will give you many enjoyable hours of perating pleasure.

. . . K4PFK

A Basic ac Conversion and Conversionless Mobile Installation of the RT-19/ARC-4 for 2 Meter Use

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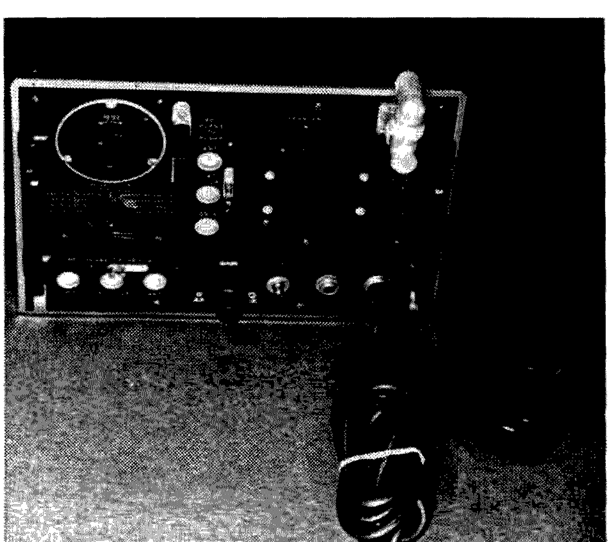
Converting the ARC-4

The AN/ARC-4 aircraft radio set is once more available on the surplus market. It offers a cheap and convenient method of getting on 2 meters. The major component of the AN/ARC-4 is the receiver-transmitter RT-19/ARC-4 which provides four relay-selected, crystal controlled channels in the frequency range of 140 to 144 mc. No changes are required in the tuned circuits for 2 meter coverage. Power requirements for aircraft use were 12 or 24 volts depending on the dynamotor used. Power output of the AM transmitter is a nominal 8 watts into a 50 ohm load.

The widespread interest in fixed frequency, 2 meter mobile and home station net operation enhances the value of crystal controlled surplus equipment. Further, the swing to 12 volt automotive electrical systems means that much surplus equipment (such as the AN/ARC-4) which formerly required extensive modification now has immediate and practical amateur application. This article describes a conversion-less mobile application of the equipment and a simple, low cost basic ac conversion. Various refinements including internal speaker, rf and audio gain controls, channel selection system, squelch control, front panel transmitter crystal socket and receiver VFO were incorporated in the prototype and are presented separately to permit optional inclusion. The mobile application is presented last since it would require duplication of data that is essential to the understanding of the ac conversion.


Front panel of the converted receiver.

The photographs show construction details of the equipment. A 6V6 crystal oscillator drives two 6V6 and one 1616 (6L6) frequency multiplier stages which drive an 832 PA stage. A carbon microphone circuit feeds the push-pull 1614 modulator stage. The receiver section consists of two identical front ends which feed common *if* and audio stages. The two receiver sections, PLANE TO PLANE and PLANE TO GROUND, permit simultaneous monitoring of two frequencies. These sections consist of a 6AC7 mixer, no rf stage unfortunately, with two 6N7 tubes serving as crystal oscillator-multiplier stages to generate the HFO injection voltage. Three 12SJ7, 10 mc *if* stages follow, driving a diode detector, noise limiter and squelch circuit using two 12SQ7 tubes. Two 12A6 tubes, with a common grid circuit, provide two independent 500 ohm audio output channels.

The usual power requirement conversion problems exist in the AN/ARC-4. However, the availability of low cost, silicon diodes greatly simplifies the solution and makes the use of a 12 volt dc supply economically feasible and certainly far easier than rewiring of the circuits. Use of salvage TV power supply components reduces the power supply costs to the vanishing point. If you are lucky in your choice of a transformer, all the com-

ponents may be housed in the ex-dynamotor compartment. If not, the solution shown in the photographs may be used. The transformer is mounted on the back chassis wall and a clearance hole cut in the back of the case.

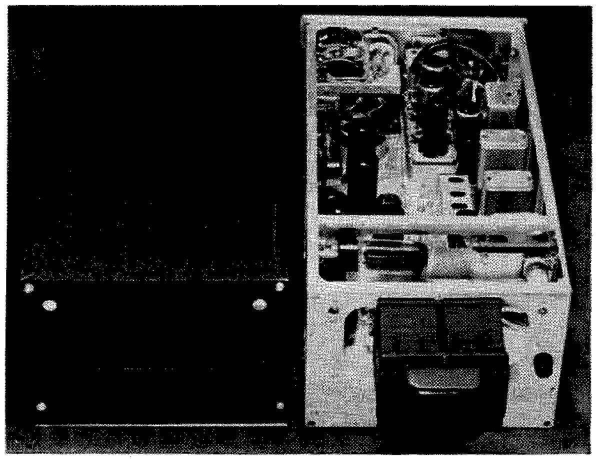
Loosen the two single-turn fasteners at the rear of the case and slide the chassis out. Remove and discard the two mounting angles at the bottom of the front panel, reinstalling the screws to fill the holes. Remove the dynamotor and take off the connector before discarding. Clean the connector up and install on the original plug.

The following steps remove the dc control relay, S6C and terminates the on-off switch, D1C, on the main power connector, PG1C, to permit use with the ac power supply. Remove the mounting hardware for the following components located at the rear of the chassis: relay S6C, resistor R4C and choke L2C. Unsolder the two white with yellow-yellow tracer wires from the inside chassis end of L2C. Unsolder the other end of one of the leads from Pin 2 of the dynamotor connector and discard. Dress the end of the other lead, which terminates on Pin 3 of the main chassis connector, to Pin 2 of the dynamotor connector and solder in place. Unsolder the white with brown-brown tracer lead from the junction of the S6C relay contact and resistor R4C. Unsolder the other end of this lead from Pin A1 of PG1C, leaving the second lead on this pin undisturbed. Unsolder and discard the white with blue-orange tracer lead running between the junction of the S6C relay coil and resistor R4C and Pin 8 of the main power connector. Unsolder the white with blue-orange tracer lead from the coil of relay S6C ınd solder this lead to Pin A1 of PG1C. Discard relay 56C, resistor R4C and choke L2C. These changes are ;hown in **Fig. 1A**.

All the required circuitry to accomplish the basic AC ·onversion and certain of the options is now available at he main power connector, PG1C, and the dynamotor onnector, PG2C. Secure the matching female receptacle ɔr plug PG1C, a Cannon DP-D32-33S, and mount in ıe center of the top of a Bud CU-2101, 3¼" × 2⅛" × ⅝" Minibox. The details are shown in the photographs. 'his box serves the dual function of a protective cover ıd as a convenient mounting for the switches required certain of the options. Permanently strap Pins 3, 7, 9 ıd 10 on the back of the connector. This ties all +12 ɔlt circuit points together and connects them to Pin 2 the dynamotor connector. Permanently strap Pins 6, and A2. This ties the filament return circuits to ound and connects them to Pin 1 of the dynamotor nnector. Now strap Pin 19 to the same group. This mpletes the modulator cathode circuit which is disabled certain aircraft interphone applications.

Strap Pins 16 and 17 which completes the B+ circuit 1 connects it to Pin 7 of the dynamotor connector. nnect an AC line cord, at least 16 gauge, to Pins 1 1 A1. Strap Pins 2 and 20. This completes the AC :uit through switch D1C and supplies 115 volt AC to ıs 5 and 6 of the dynamotor connector. The following ınections may be removed to install optional features l should be made so as to be readily removable. Strap s 18 and 28 which applies screen voltage to and thus vates the PLANE TO GROUND channel receiver. ıpping Pins 18 and 29 activates the PLANE TO ANE channel and strapping all three pins provides :ption on both channels. Ground Pin 14 which ac- :es the relay connecting the back crystal unit to both transmitter and the PLANE TO GROUND receiver. ıporarily ground Pin 4. This grounds the B-return provides a quick and dirty means of changing the l squelch bias and disabling the squelch circuit. This pletes the preliminary work and the power supply now be installed in the ex-dynamotor compartment.

; previously mentioned, this conversion draws heavily ;alvage TV set power supply components. Choose a ge TV transformer with a secondary capable of lying a minimum of 300 volts DC at a minimum of MA. In addition to a 5 volt at 3 ampere winding, 6.3 volt windings rated at 5 amperes minimum are



Rear view of the converted receiver showing the transformer cutout.

required. The matching TV filter choke should also be secured. The units shown in the photograph are from an old Philco chassis and they run only warm in this application.

Arrange the components so that all fit with comfortable clearance and mount them in place. The photographs will serve as a guide but exact placement will depend on the specific components used. The silicon diodes specified provide a comfortable safety factor but a heat sink is still required. Mount the diodes, using insulating washers, to an aluminum bracket and secure the bracket to the chassis. Standoff posts may be used to mount the tube socket and high voltage filter capacitor. Note that the capacitor must be insulated from the chassis. Any screws through the chassis side panels must be countersunk so that the case be installed. The fuse post is mounted on the back of the chassis and a clearance hole punched in the back of the case. After all components are mounted, wire in accordance with Figure 2. After wiring is completed and checked, locate the microphone transformer T1T and connect a 1,000 μf, 15 WVDC tubular capacitor between Pin 2 and ground.

Carefully check your work and insure that a crystal unit is installed in the rear crystal socket. The crystals used in the AN/ARC-4 are Western Electric type 703A crystal units. The holder is a 3 pin device, mounting

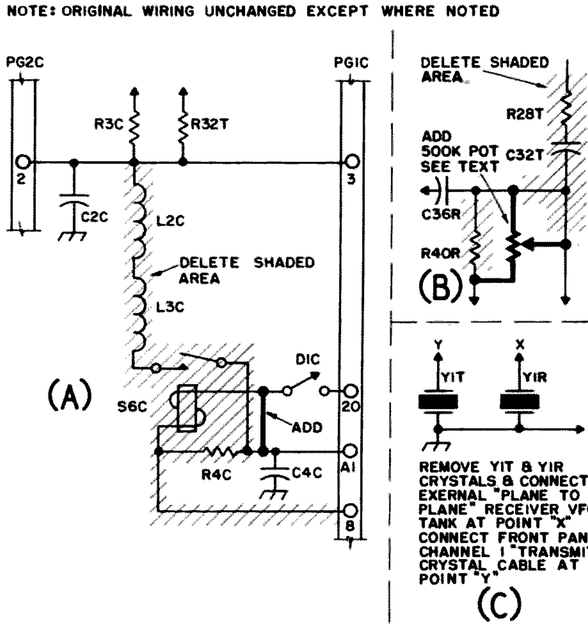


Fig. 1. Internal wiring changes.

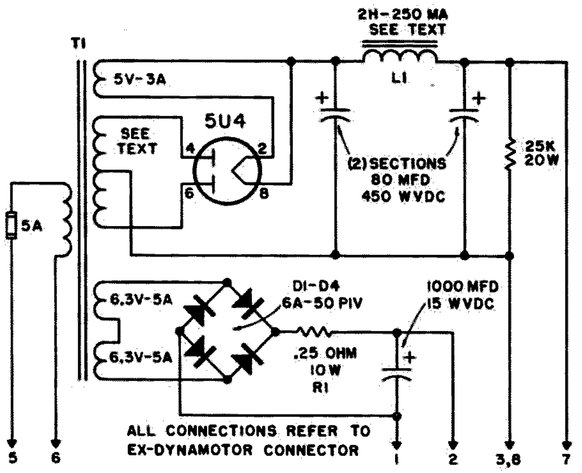


Fig. 2. Power supply.

both the transmit and receive crystals. The blanks used are 11/16" square which is not too commonly used in surplus crystals. Since the design range of the equipment is 140 to 144 mc, there is little chance of getting surplus 703A units to fall in the 2 meter band. Those who desire may grind the crystals to the desired frequencies. While the technique is not difficult, it is beyond the scope of this article. The 3 pin sockets may be changed to the dual FT-243 type and these inexpensive surplus units used. In any event, the formulas are as follows:
Receiver:

$$\text{Receiver:}\quad f = \frac{F\text{-}10}{16} \times 1{,}000$$

$$\text{Transmitter:}\quad f = \frac{F}{24} \times 1{,}000$$

Where: f = Crystal Frequency in kcs
F = Carrier Frequency in mcs.

Therefore, for 144-148 mc coverage, the receiver crystals range between 8375.000 and 8625.000 kcs while the transmitter crystals range between 6000.000 and 6166.666 kcs.

Connect a 6 to 10 watt, 115 volt lamp to the antenna connector and plug a 0-1 madc meter into the front panel metering jack. Turn the meter switch to the FILAMENT position and apply AC power. Turn the power switch on and the rear crystal relay should close while the meter deflects to about half scale. The tube filaments should also light. Throw the meter switch to the PLATE position and the meter should read around 0.6 ma. Now plug in a carbon microphone of the T-17 type. Turn the meter switch to the OSC IG position, depress the mike switch and the meter should read approximately quarter scale. Switch to 1ST HG IG adjusting L1T and L2T; switch to 2ND HG IG adjusting L3T and L4T; switch to 3RD HG IG adjusting L5T and, finally, switch to RF AMP IG, adjusting C6T and L8T. In each case, tune for maximum current and the meter readings should fall between quarter and half scale. Now switch to RF AMP IP and adjust L9T for minimum current while adjusting C10T until the meter reads about half scale with L9T resonated. The lamp load should light brightly at this stage. Throw the meter switch to AUDIO AMP IP and whistle into the mike. The lamp load should glow brighter and the meter should swing upward from approximately half scale.

Now that the transmitter is out of the way, the receiver may be aligned. With a crystal installed, throw the meter switch to OSC IG and adjust L1R. As the slug is screwed in, the meter should climb to a peak and then abruptly drop to zero. The proper setting is approximately 80% of the maximum reading. Switch the meter to 2ND HG IG, adjusting L2R, and then to 3RD HG IG, adjusting L3R. Adjust for maximum meter reading which should be between 0.1 and 0.2 MA. Now connect a

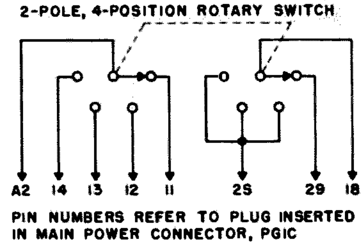


Fig. 3. Channel selector.

VTVM to the AGC line and adjust L4R for maximum negative voltage. Connect an antenna and adjust the front panel PLANE TO GROUND trimmers for maximum receiver noise. These trimmers must be peaked and a signal generator or a reliable local signal is a big help.

This completes the basic, single crystal controlled frequency, AC conversion. The easiest to add refinement provides selection of any of four transmit and receive frequencies. Remove the main power connector-box assembly and take the cover off. In one end of the box, mount a small 4 position, 2 pole switch. Lift the temporary ground connection from Pin 14 and remove the jumper between Pins 18 and 28. Now wire the switch circuit as shown in Fig. 3. This provides reception of Channels 2, 3, and 4 on the PLANE TO GROUND receiver and reception of Channel 1 on the PLANE TO PLANE receiver. Switching of the receivers is automatically taken care of by the second section of the switch. Alignment of the PLANE TO PLANE receiver is identical to that of the PLANE TO GROUND receiver except that the meter switch is placed in the RF AMP IG position. A test lead is then patched from the P TO P HG IG test jack on the left side of the chassis to the 3 test jacks located on the top of the PLANE TO PLANE unit. Work from rear to front on these adjustments.

Squelch control is easy to add to the receiver. Simpl install a SPST toggle switch on the end of the powe connector box opposite the channel selector switch. Lif the temporary ground on Pin 4 of the connector an wire from A2 to 2. Closing the switch will now disabl the squelch.

A dual RF and AF gain control may be installed i the THROTTLE SWITCH jack hole. Remove the jac and clip the single wire where it terminates on the micr phone jack. Mount a dual, concentric shaft, 100,000 oh linear taper and a 500,000 ohm audio taper control in t hole. Remove the mounting of the existing RF gain co trol, P1R and mount a 2 lug tie point at this locatio Terminate the two series resistors, R24R and R64R, this tie point. Remove the lead presently connected Pin 4 of V4R and solder 18" leads to this pin and the 2 point lugs. Route the leads down the center of the chas to the new control and wire to the 100,000 ohm sectio The lead connected to R24R should go to the count clockwise lug.

Connect a two conductor shielded cable to the 500,0 ohm section of the new control with the ground l attached to the counterclockwise lug. Route the ca down the center of the chassis to the vicinity of the t 12A6 audio output tube sockets. Remove the white w green-green tracer lead which runs from Pin 5 of front 12A6 to a 100,000 ohm resistor, R40R, moun on a terminal board just forward of the tube socket. move the resistor and ground the braid of the new ca to the same ground point. Connect the lead running the "hot" contact of the control to the bottom lug f which the resistor was removed. Connect the lead runn from the center arm of the control to Pin 5 of the f 12A6.

The modulator feeds audio into receiver audio ampl to provide sidetone and this must be removed to a feedback if a speaker is used. Locate the white green-green tracer lead which is connected to Pin the back 12A6 and enters the wiring harness. Clip lead from Pin 5 and pull through the wiring harnes where it terminates on the back terminal board. Rer

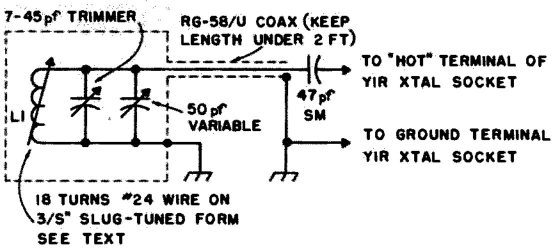


Fig. 4. Receiver VFO converter. Range is 8.3 to 8.7 mc.

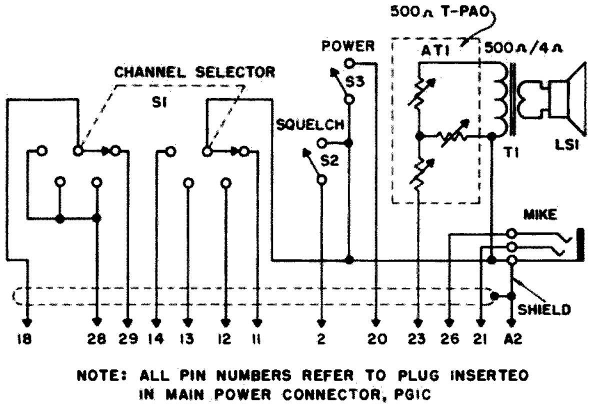


Fig. 5. Remote control box for mobile use.

this lead and the two series connected components on the terminal board. These parts, R28T and C32T, a 270,000 ohm resistor and a 5,000 pf capacitor are connected to Pin 5 of the outside modulator tube socket. Remove and discard this lead. See Fig. 1B changes.

A 4" PM speaker and line matching transformer may be installed as shown in the photographs. The speaker is mounted over a 3" × 4" chassis cutout which in turn lines up with a set of ventilation holes in the case. The Merit A-3005 transformer matches the 500 ohm receiver output to the speaker voice coil. Mount the speaker and output transformer using countersunk flat head screws.

A front panel transmitter crystal socket may be installed with only minor circuit changes. However, this flexibility would not be of much value without a continuous tuning receiver. This is not difficult to accomplish. Since the PLANE TO PLANE receiver is used only on Channel 1, the Channel transmitter crystal socket is extended to the front panel and the PLANE TO PLANE receiver is converted to continuous tuning using an external tank circuit. Operation of the remaining channels is unchanged.

Carefully spot and drill holes for mounting an FT-243 type crystal socket immediately to the right of the meter. Mount the socket and, using a short length of RG-58/U cable, wire the new socket to the front transmitter crystal socket. A salvage FT-241 or FT-243 crystal holder may be used to terminate this cable. Before this change, active FT-243 crystals were required. With the added capacity of the cable, two capacitors must be changed to make the oscillator reliable. Locate the 50 pf capacitor, C2T, which is wired directly from Pin 5 to Pin 8 of the oscillator tube socket, V1T, and replace it with a 39 pf mica capacitor. Locate the 390 pf mica capacitor C3T, which is connected across the oscillator cathode inductor, L1T, and replace it with a 100 pf unit.

The PLANE TO PLANE receiver crystal oscillator becomes a tuned plate, tuned grid oscillator. A parallel tuned tank circuit which tunes the basic crystal range of 8375 to 8625 kc is connected to the existing crystal socket through a capacitor. No other circuit changes are required. While the tank circuit could be installed internally, there is little panel room for an adequate dial. The decision was therefore made to use an external tank circuit very much the same as the popular "tubeless" VFO's. Install a single hole mount BNC jack, an UG-625/U, immediately to the left of the meter and slightly below the top meter mounting hole. Connect a length of RG-58/U to the jack, grounding the shield. Extend this cable to the PLANE TO PLANE receiver crystal socket. Solder a 47 pf mica capacitor to the above ground terminal of this socket and connect the center conductor of the cable to this capacitor, grounding the braid at the ground terminal of the socket.

The external tank circuit may be mounted in any convenient cabinet and fitted with an available dial. However, the interconnecting cable must be kept short. The prototype which was installed after the photographs were taken was housed in a 3" × 4" × 5" utility box mounted to the left front side of the case. A short cable, fitted with BNC connectors, was used to join the two units. The schematic of this unit is shown in Figure 4. The coil used is a slug tuned, 3/8" diameter surplus unit with 18 turns of #24 wire. With the parts values shown and with the cable capacity of the unit described, the VFO tunes from 8300 to 8700 kc. Wire the unit as shown and connect to the receiver circuit. Now, by the usual plate bending and slug adjustment, bring the unit to the desired frequency coverage. A grid dip meter is helpful in the first approximation and, after the unit is oscillating, a well calibrated receiver or frequency meter may be used for the final adjustment. Operation of the receiver is the same as for crystal control except that retrimming of the front panel adjustments will be required for any great frequency excursion.

As was mentioned, the AN/ARC-4 is ideal for fixed frequency, mobile net operation. When you purchase your set, get a mounting base thrown in (they are a drug on the market) and insure that the set has the type DY-10/ARC-4X dynamotor installed. This is a dual-voltage, 12 and 24 volt unit, while the more common DY-9/ARC-1 is usable only on 24 volts. A number of mounting bases are suitable. The MT-100/ARC-1, MT-101/ARC-4 and the MT-230/ARC will all accept the RT-19/ARC-4. The only material difference is that the AN/ARC-1 bases have the main connector reversed and that different output connectors are used. To avoid confusion, the installation described uses cables connected directly to the main connector of the mounting base.

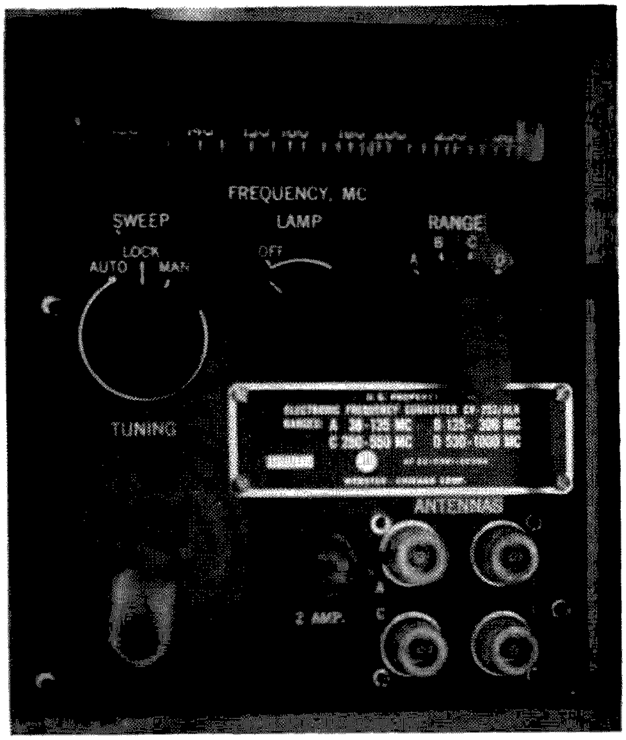
The mobile installation described is for trunk mounting of the set in 12 volt, negative ground cars. A small control unit which includes a speaker, line matching transformer, audio level pad, squelch control, channel selector and power switch is mounted under the instrument panel. Fig. 5 shows the schematic diagram of this installation and lists the power connector strapping, the purpose of which has been described. Prior to installation, one internal wiring change is required on the dynamotor plug to permit remote squelch control. Strap Pins 5 and 8 which brings the B— point out to the main power connector.

Remove the wiring from the shock mount base, clean up the main chassis connector and discard the others. Install the mounting base in the trunk compartment and run in the antenna and primary power leads. Since the unit draws 14.5 amperes in the receive and 21 amperes in the transmit condition, use at least #4 wire and route directly from Pins A1 and A2 to the car battery. A 12 conductor cable plus ground is required to run between the mounting base and the control unit if all the described features are made available. Conductor size is not important and any available 12 conductor shielded cable may be used.

Operation is much the same as for the AC conversion. The PLANE TO PLANE receiver is used as the Channel 1 receiver while the PLANE TO GROUND receiver is used on the other channels. Crystal data is unchanged. Remote operation of a receiver VFO was not considered feasible and was not attempted. Set the RF gain control for best signal to noise on a moderately weak received signal and control output level with the audio pad.

While the performance of the AN/ARC-4 is not state of the art by any means, it provides a low cost answer to getting on 2 meters. Both the AC conversion and the mobile applications are fully feasible and are within the capabilities of even the inexperienced amateur.

. . . W4WKM



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The CV-253/ALR Converter

Recently there appeared on the surplus market a very interesting piece of equipment. It is called technically, "Electronic Frequency Converter CV-253/ALR." Actually it is a tunable converter covering the range from 38 mc to 1000 mc. This coverage entails most police and fire departments, the 6m, 2m, 1¼m and ¾ meter amateur bands, FM broadcast, TV, taxicabs, airlines, etc., etc., and who only knows what else up there.

The unit originally was used to replace the 4 tuning heads used in the old APR-1 or APR-4 radar search receivers. The -1 or -4 denotes the bandwidth of the 30mc *if* strip in the search receiver. The drawbacks to the old type tuning heads were legion: you changed heads to change the range; you had no rf stage ahead of the mixer (granted you have none in the two highest ranges of the new model, but the diode mixer compensates for this by lowering the noise figure of the new head considerably), with no rf stage you had no preselection. This resulted in receiving signals such as fc (receiving frequency), fc + fi (intermediate frequency), fc − fi, fc + 2fi, fc − 2fi, fc + 3fi, etc. With the tuned rf stage in sections A and B we get the preselection necessary to reject such suprious signals. In sections C and D, you have two cavity-tuned preselectors. The two cascaded cavities have a Q in the high thousands region, thus assuring a very good rejection of wanted signals.

I picked up one of these units, complete in sealed box (overseas crate, similar to cast iron coffin), as a lark, just to see what Uncle Sam calls an electronic frequency converter. When I passed through the packaging barrier and reached the lower level of packing, I began to realize the golden egg was here. When finally unwrapped, I undid a few screws, removed the covers and gazed upon the nicest looking packaging job I've seen in quite a while. One word of warning, when loosening the screws, unscrew only 1½ turns on each with exception of the two on the side covers near the front. The genius who designed this did away with nuts and bolts as such. The screws are anchored by a threaded plate and the covers are slotted to facilitate easy removal in a matter of seconds. Just think, there are only four screws that can be lost. What's the surplus world coming to?

Inside the unit can be found all the pertinent data needed for alignment and testing. It is printed on the inside of the two covers and on all subchassis inside the unit. No more can you scurry around trying to find the extinct instruction book, or twiddle screws trying to

find out which does what, or spend fruitless hours tracing out a circuit which uses all the same colored wire. No more do you have to take apart the entire unit to find out where the power goes, or get electrocuted while applying power to the unit when it's spread out all over the table. I feel I am witnessing the passing of a nostalgic era.

The two covers are marked as to their function, and what is printed underneath. Removing the cover which has the schematic printed on it, I found all I needed to put the unit into operation. Checking out the unit I discovered several interesting points.

Although all filaments run continuously, the converter has the disadvantage of having the oscillator plate voltage switched when changing bands. This causes a drift problem, which we will settle later in this article. The unit requires +300 VDC for rf, oscillator and mixer plates (purists need not cringe at this voltage on the mixer, as a dropping resistor inside the unit lowers the mixer voltage to a decent potential), 6.3 vac at 1.6 a. If you decide to use the search potential you'll need 28 vdc. It's a device which would be nice for band scanning to check for band openings by watching the MUF. A buit-in feature is that you can set limits for scanning, and the unit is self-reversing when reaching the end of the scanning area.

The most drastic change needed is to build a stiffly regulated power supply at 300 v at 100 ma to run the unit. Any handbook will help here. Then go inside the unit and tie together all B+ leads to a common point. This allows all 4 bands to run continuously. These points may be found under the righthand cover (with unit facing you). There is a terminal junction strip, midway between band C and band D sections. It has six shielded terminations and four single lead white terminations. These four white terminations are the B+ check points of the unit. Jumpering these four together puts B+ on all four sections simultaneously.

A good idea is one the military uses; it costs money when the electricity bill comes in, but in some cases it might be worth it. They let their receivers run continuously, 24 hours a day, 7 days a week, even when not being used. This results in higher stability, longer tube life, and avoidance of long waits for the oscillator to quiet down.

The sensitivity of these units is quite remarkable. In measurement of sensitivity the better the equipment used, the more accurate are your figures. Lacking the fancy stuff, I had to rely on the data sheet found inside the box along with the tuning head. Since the unit was unused, I feel quite certain these figures are accurate. The numbers are quite low, *i.e.*, and 0.9 μv at 38 mc, 3.3 μv at 2m and 220 mc, and 9 μv at 430 mc. Of course it's nothing like a good crystal-controlled low-noise front end converter, but for the quickest and cheapest way to get on all amateur VHF bands (up to 432) it can't be beat. The bandwidth of the unit makes it an excellent device for wide-band FM work, and ATV work.

Connections to the rear can be made by banana plugs to hook up the plate voltage, filaments and search motor voltage. The *if* output is another problem. The connector is of the GR 50 ohm type, and unless you have access to adapters, it is wise to change it. Removal of the connector is quite simple and it is easily replaced with a type N connection. Don't squint at using such a fancy connection at 30 mc. I belong to the school that doesn't like 225 ohm bumps in my coax line, as you get from a type UHF connection. If you read fine print, you find that the only true 50 connections available readily to hams are the BNC type, used on RG-58/U, 62/U, 59/U, etc., type coax, and the type N unit used with RG-8U, 9/U, etc., type coax. The type N, by the way, will handle 1 kw cool and sweet up the 500 mc.

The antenna connections are made on the front, with separate connectors for each band. This eliminates switching antennas with band change.

You're all set, get up some antennas and join the fun on UHF, or if you get tired you can always listen to TV (minus the boob tube) or drop in on fire or police calls. You'll find it fun, no matter which you choose.

. . . W1KSZ

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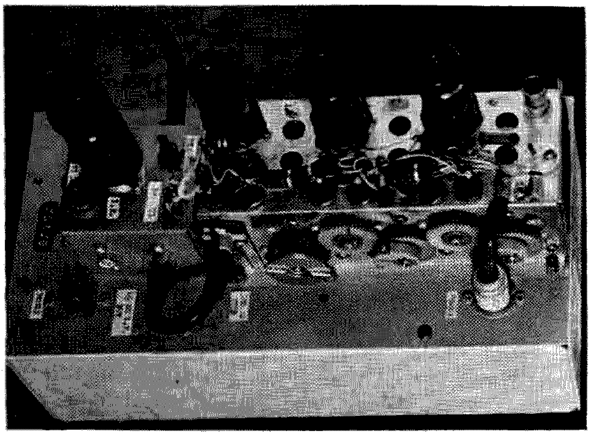


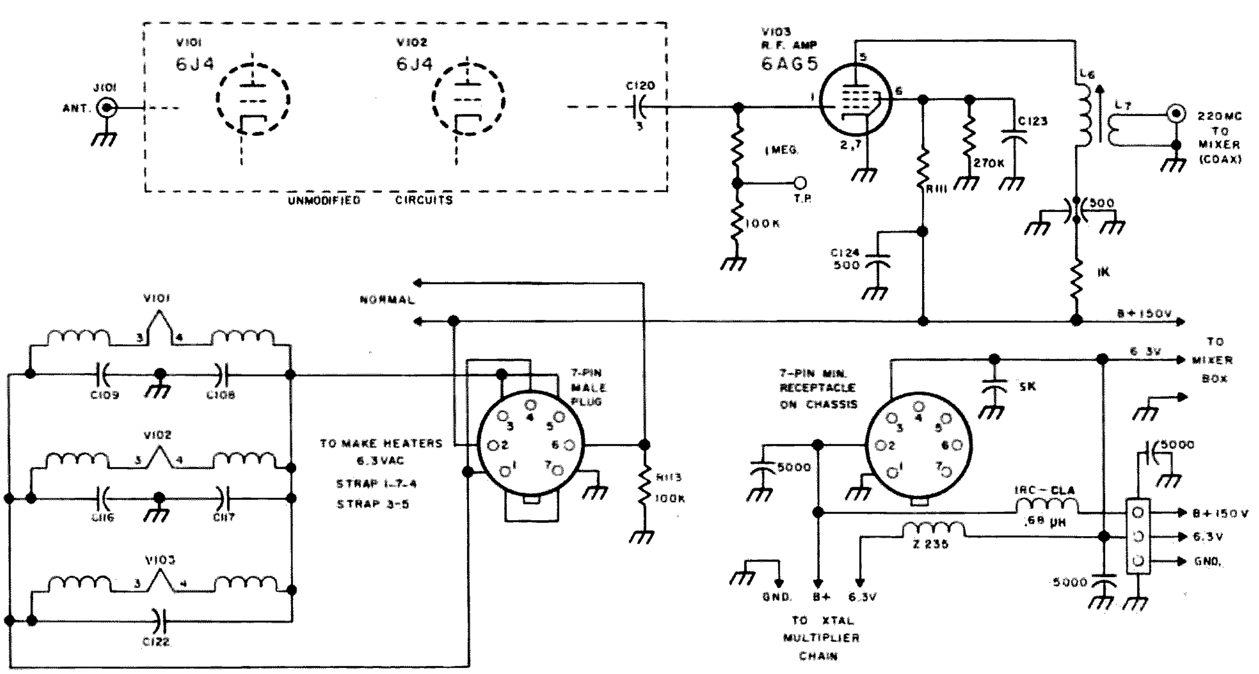
Mixer and modified rf amplifier.

220 mc Converter from the ARC-27

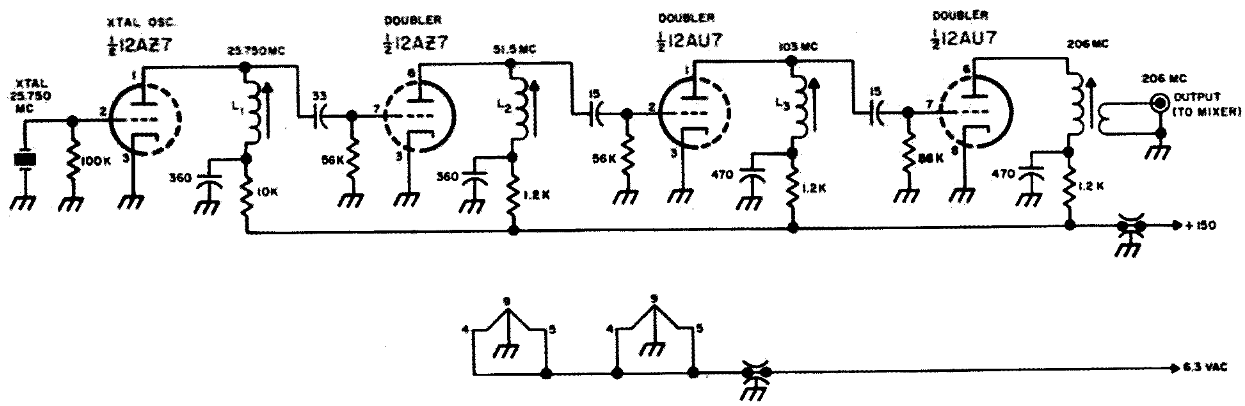
A very nice 220 mc converter may be constructed around the RT-178/ARC-27 main receiver RF amplifier subassembly. This particular unit, which is a small module containing three tubes, is used in the ARC-27 as the front end of the main receiver which tuned the usual military range of 225 to 399.9 mc. Since it will actually tune the 220-225 mc amateur band as well without any modifications to its tuned circuits, the results are good for ham use.

This article will describe how the sub-assembly may be mated with a crystal-multiplier chain and mixer to form a completed 220 mc converter. One of the main advantages of such a converter as this is the rf selectivity afforded by three sharply tuned, high "Q" 220 mc tank circuits. This is in sharp contrast to the usual broad-band crystal controlled converters, that are so commonly used these days.

On 220 mc in many localities considerable



Modified ARC rf assembly.



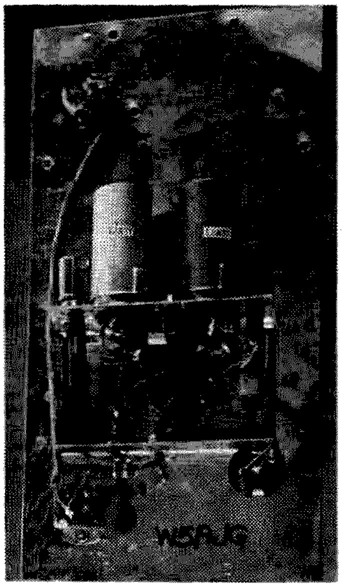
Crystal oscillator and multiplier string. L1 is 26 T, L2 is 12 T, and L3 is 5 T. All are on ¼ in. forms with iron cores. L4 (206 mc) is 3 T on ⅜ in. ceramic form with iron slug. The output link is 2 turns on cold end.

trouble has been experienced with various TV-FM spurious or birdie signals due to undesired mixing, overload, leak-thru, etc, from these powerful signals. By using some sharply tuned rf ahead of the mixer tube at 220 mc, an unusually clean response is obtained overall. Bear in mind, however, that when excursions across the band exceeds more than a couple of hundred kilocycles, it will be necessary to touch up the rf tuning a bit. This is actually a small price to pay for the results obtained and it is actually fun to be able to peak up on each individual received.

As for a source of supply—these units are to be found in surplus and more especially in local junk-yards. One must know the appearance of the unit and just what to look for. The ARC-27 set is beginning to show up in increasing supply and various parts and pieces of the unit are also showing up along with the more or less complete hulls. Often, these sub-assemblies are new in original packing, having been stocked for spare parts, and are real desirable pieces of UHF gear.

The Collins part number appearing on the main rf amplifier unit is 505-4390-005, if that is of any help. A reference to the photograph of the topside of the completed 220 mc converter will illustrate its appearance. Be on the lookout for one next you scrounge your junk-yard. To describe this unit a bit—we should start by saying that two stages (V101, V102) of rf preamplification using type 6J4 triodes are used in a grounded grid configuration. As in most all other sub-assemblies of the ARC-27, the tuners are of the "Hubbard" variety. They are all ganged by means of a series of meshing gears and all three tank circuits contained may be tuned very easily as one peaks across the band. The third tube (V103) is a type 6AG5 mixer stage. This stage as is, could not be made to work very well, since the original purpose was a bit different from our requirements. Therefore, it was made into a 3rd rf amplifier stage, and an additional mixer tube was built up in a separate minibox and mounted adjacent to the rf stages. This 6AG5 stage (V103) is the only portion of the procured assembly that needs a bit of changing—and this change consists of adding a plate coil resonant to 220 mc and a coax couplint link to be fed into the new mixer box.

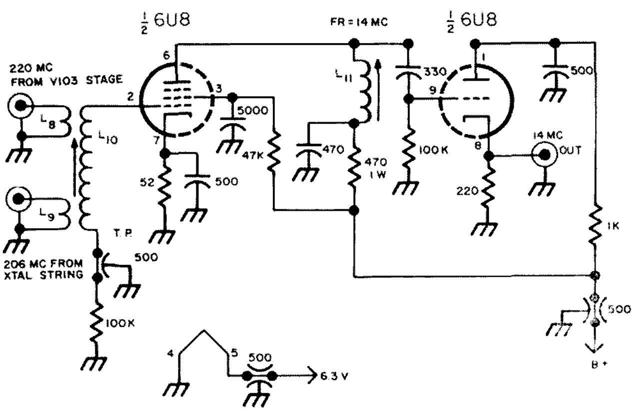
For an oscillator-multiplier chain, another shielded enclosure is used, containing two tubes, one type 12AZ7 and one type 12AU7. This box is mounted underneath the chassis plate and is bottled up tight, with its injection output being fed to the mixer box only via a short coax cable. Since an *if* of 14 mc is used for all converters here at W5AJG, the crystal chain starts with a frequency of 25.750 mc. The progression is then $2 \times 2 \times 2$, in the remaining three triode sections of the two tubes. It was found that the old-fashioned doubling method was more stable, reliable and produced more output than starting with a



Bottom view of converter showing oscillator - multipliers and power connectors.

Photos by Jim Dungan

MIXER-CATHODE FOLLOWER



Mixer. L8 and L9 are 2 T links. L10 is 3 T #18 tinned on ⅜ in. ceramic form with iron slug. L11 is 30 T #28 enamelled wire on ⅜ in. iron cored slug.

very high frequency crystal and fewer stages. Link coupling from the injection string to the mixer and ample tuned circuits, along with power lead filtering, results in no spurious unwanted beats. Should an *if* other than 14 mc be desired, the string may be altered to suit the desired frequency.

Modification And Construction

The converter is assembled on a fairly heavy thickness aluminum plate 5 × 10 inches in size, to fit a stock BUD chassis box of 10 × 5 × 3 inches. Copper or brass may be used for the plate if desired, but it is not necessary since the converter will consist of three separate mounted boxes—the converted ARC-27 portion, the new mixer box and the new oscillator string compartment box.

Not too much work is involved in modifying the unit. (Fig. 1) First, the filaments or heaters should be changed over to 6.3V ac operation instead of the original 24V dc hookup. This is quite simply done by a couple of wire straps. Terminals (3 to 5) as well as (4 to 1) should be connected together and 6.3V ac fed into terminal 3.

Next the avc line on V101 and V102 should be grounded by strapping terminal 7 to terminal 1, with terminal 6 being unused. Of course, if avc is actually desired on the converter, then terminal 7 could be connected into the companion receiver avc bus. At this particular location, avc on the converter was not needed or desired.

Next change V-103 into the 3rd rf amplifier. It might seem that the pentode 6AG5 is a poor choice for an rf amplifier, but since the NF has been set by the two previous 6J4's, its use will be satisfactory here. By referring to the modified schematic once again, it is apparent that L6 and L7 have been added. L6 is resonated at 220 mc with the

aid of a GDO and L7 is a two turn link to be used to couple by coax cable the output of the preamplifier to the new mixer box. Test point T-P may be used to be sure the previous rf stages are peaked on the nose. This should complete the pre-amplifier unit.

Now for the new mixer tube (Fig. 2). This is a type 6U8 and is employed as a mixer-cathode follower with output at the *if* frequency of 14 mc. This box enclosure is of the mini-box variety and can be a standard 1.75 2 × 2 inch size. Again referring to the top-side photo, it can be seen that on the left is the coax cable carrying the crystal string injection—and on the right is the input carrying the 220 mc preselection, also in a coax cable, as well as the output connector for the 14 mc. *if*.

Input coil L10 is GDO'ed to 220 mc and the two input links wrapped around the cold end of same. The remainder of the mixer-follower circuit is perfectly vanilla and should present nothing tricky in character. The test point labelled (T-P) is very convenient to measure for the proper amount of injection being produced by the crystal string. More on this item later, when we tune up.

This leaves the oscillator-multiplier section in the shielded compartment underneath the chassis plate which contains the two double triode tubes (Fig. 3). The crystal oscillator is a 25.750 mc unit, and the second half of the first triode (12AZ7) doubles to 51.5 mc. From this point, it drives into the second triode (12AU7) which doubles to 103 mc and thence into the last triode section to double again to 206 mc. This output is transferred via coax cable to the mixer box top-side of the chassis plate. The coupling links are adjusted so that the proper injection voltage reaches the grid of the mixer tube as mentioned above. Ordinary iron slug coil are used, some phenolic and some ceramic as indicated. The complete converter power supply requirements are: 150 V dc at 50 ma and 6.3v ac at 2.5A.

Operation And Tune Up

The crystal oscillator string should be checked with a GDO or absorption meter to see that all tanks are resonating at the proper frequencies. Apply power and check for proper voltages on the plates of the 6J4's. They should measure about 100 volts. Using a signal generator coupled to input receptacle J-101 and set at a frequency of 220 mc—adjust the gears on the ARC-27 unit for maximum signal. Trimmers Z101A, Z102A and Z103A associated with the Hubbard tanks can be peaked at this time. The 6AG5 plate slug and the mixer input slug are next adjusted for maximum signal. At this stage, the test point (T-P) on the mixer grid is checked with a VTVM. Voltage as measured at this point should run between −2.0 and −4.5 volts. If it is low, repeak the oscillator-multiplier string coil slugs and the adjustment of the coupling loops, L5, L8 and L9 for maximum transfer of energy. Ample injection voltage should be available without sweat.

When the signal has been maximized with all trimmers and slugs, the generator can be replaced with the antenna. At this point, a goodly amount of ignition noise should be heard (unless you live on cloud 9) and this will be a good sign. From here on, the best way to tweak up all the controls is with an on the air weak 220 mc signal from out of town. It just can't be beat. Do not peak up on a strong signal—null the antenna if necessary until the signal is just above the noise, and then readjust all controls. Means for measuring the absolute noise-figure are not available at this station, so no claims can be made. The 6J4 triode has a pretty good figure of merit and a transconductance of 12,000 micromhos, which makes it a good performer at 220 mc, and the converter should certainly be sensitive to somewhat less than one-half microvolt for a signal report of Q5. Again, means are not available here to go very much below this level of sensitivity without generator feed-through. No spurious signals were present on the 220-225 mc band when using the converter working into the station 75A4 receiver.

It has probably occured to ask if this ARC-27 rf unit would work on 432 mc since the top range is known to be 399.9 mc. Yes—by removing or bending back some of the rotor segments of the Hubbard tanks, the GDO will indicate resonance at 432 mc. This was actually done on a second unit and an attempt was made to use the assembly as a 432 mc preamplifier ahead of the 432 mc receiver in station use. Results were rather disappointing however, mainly due, it is thought, to the problem of coupling out of the unit into a low impedance coax line. V103 was not used in this instance, as the pentode 6AG5 is not suited to this frequency. It would be necessary to change out this tube type with something better. This would all turn out to be somewhat of a major construction task, and it is for for this reason that it is felt that the main worthiness of the unit is for operation on 220 mc and not it's potential 432 mc usage.

Thanks to fellow amateur AF5QOA for his help in completing this project. . . . W5AJG

Need a GDO good to 500 mc? Here's an easy conversion for the UHF men.

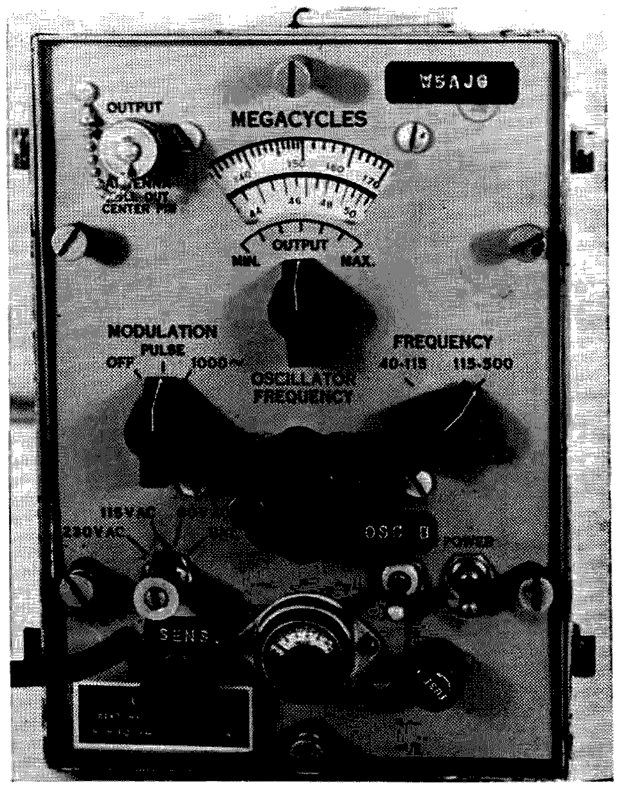


Photo credit: Jim Dungan

Adding GDO Features to the TS-47A/APR

Leroy May W5AJG
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Dallas 18, Texas

The surplus Test Oscillator TS-47A/APR is a compact self-contained calibrated oscillator originally designed by the General Radio Company during WW II. It was first described in the G. R. Experimenter in November 1946 and provides a calibrated VHF-UHF signal source.

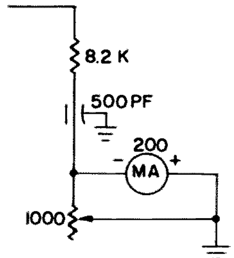
The frequency range is from 40 mc to 500 mc, fundamental in two bands—40 to 115 mc and 115 to 500 mc. The oscillator tube is a type 9002 and is used in a semi-butterfly tank circuit configuration.

The output signal may be straight CW, or modulated at 50% @ 1,000 cps sine-wave, or a pulsed 500 cps with a 70 micro-second pulse width. Power input is either 115 or 230 volts ac, 50 to 2600 cps, and the weight is about 15 pounds.

This is an excellent instrument for the VHF-UHF man, since it covers 50, 220 and 432 mc with fundamental type signals. It was originally used for the testing of radar search receivers of the APR-1, APR-4, APR-5 and RDO class. The feature of the blocking oscillator for pulse modulation is a very fine way for checking VHF-UHF converter performance, covering the above bands. This type of alignment was covered in an article appearing in QST for March 1961. It is recommended reading. Although the reference article recommends a crystal controlled signal generator, nevertheless, the TS-47A works quite well in the pulsed position. The cost of the instrument will usually run around the same price, or perhaps a bit less, than the price of a BC-221 unit. It is not to be confused, however, with a frequency meter—being primarily an oscillator or signal generator.

After using the instrument for several years, fellow ham W5QOA, suggested the possibility of converting the unit for grid-dip oscillator service, thereby adding another useful capability to an already excellent instrument. In this manner, it would be possible to "look into" various circuits, such as coax cavities or any other configuration which terminated into, or out of, a coax receptacle. For instance, it would be possible to connect a coax

Addition of meter.



jumper cable from the TS-47 to the antenna output receptacle of the final amplifier cavity and check the resonant frequency of the cavity. In other words, anything more or less closed up and difficult to reach with the normal type GDO procedure may be checked in a number of instances with this modified signal-generator.

Additionally, other normal GDO functions, such as neutralization, feed-thru, various forms of antenna checking, etc., may also be performed, since this modification contains the usual means to disable the B plus to the oscillator and thus convert the instrument to indicate rectified rf.

Since the necessary alterations are rather simple in nature, it is felt they are well worth the time, small trouble and small expense involved to make the changes.

Modifications

1. Remove the power plug on the front panel of the instrument and install a one inch surplus or otherwise 200 micro-amp mill meter. The meter is to be mounted over the hole left by the plug removal by utilizing a "U" shaped bracket, false panel plate drilled to accept the meter, or by any other expedient means to accomplish the job. The particular meter as used here was a one-inch round International Instrument 100 micro-amp dc, which required a one-inch mounting hole. Stock No. 3-12 and sold for $4.75 from Fay-Bill Distributing Company, 79 White Street, New York 13, New York.

2. Drill a hole in the lower left area of the panel (see photo) for the 110v ac power cord. Connect this power cord to the two wires just removed from the original power plug (the two that formally carried the ac line voltage).

3. Drill a small hole in the aluminum chassis casting of the oscillator housing, about one inch below capacitor C107, to mount a 500 mmfd feed through capacitor. Remove the ground end of the 8.2k grid leak resistor from ground and connect to the inner compartment side of the new feed-thru capacitor. Connect the other side of the feed-thru capacitor to the negative terminal of the 200 micro-amp meter. The positive side of the meter is now grounded. So that the desired adjustment of the meter may be accomplished, install a variable pot of 1K across the meter to act as a sensitivity control. This control is to be mounted in an unused area on the lower left of the front panel. Refer to the photo again for exact placement.

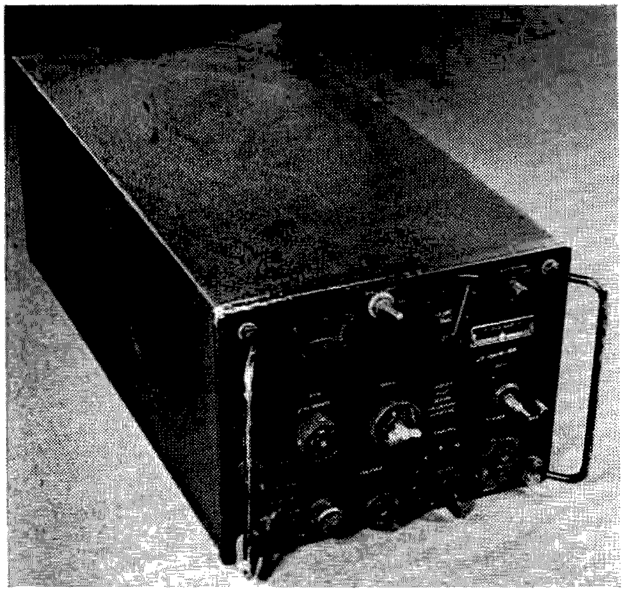
4. Normally the pilot light is controlled by a switch so as to be able to extinguish it if need be. Reconnect he pilot light to 6.3v in a permanent fashion and then use this switch to disable the B+ voltage feeding the oscillator tube, thereby providing the rf rectification feature previously mentioned.

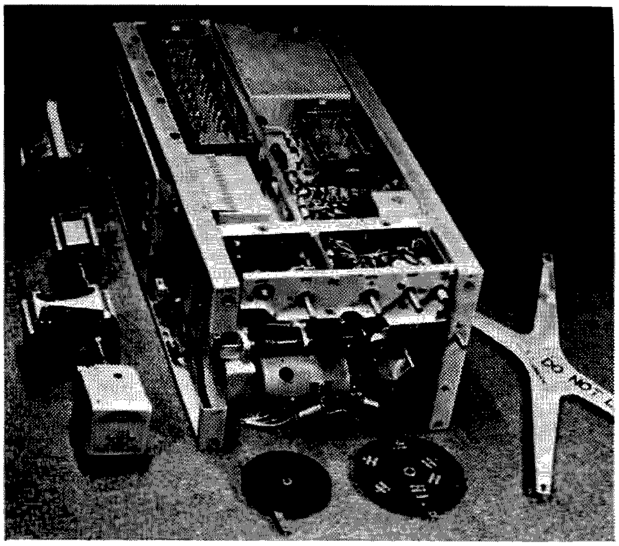
5. Make up a one-turn coupling loop on the end of a piece of coax cable to enable the meter to be coupled to open type circuits, such as exposed coils, lines, etc.

6. Use an ordinary coax cable with plugs on either end to couple the TS-47 to closed type circuits, such as cavities and other circuits that terminate in or out via coax receptacles.

Usable harmonics up to 3,000 mc may be used with the TS-47A. On its normal fundamental ranges, the output is adjustable to approximately 3 mw maximum and the output impedance is 50 ohms to a type "N" receptacle. This unit does have provisions for battery operation if it is deemed necessary. The use of the TS-47A as a signal generator for measurement of the sensitivity of a receiver in absolute values is not possible, as the shielding of the unit is not sufficient to completely bottle up the output, nor is the method of output control adequate for this type work. However, it is a very useful piece of test gear for many other purposes in the VHF-UHF frequency ranges.

. . . W5AJG





Conversion of the AN/ARR-15 provides a modern PTO receiver in the classic Collins design

A Surplus Gold Mine

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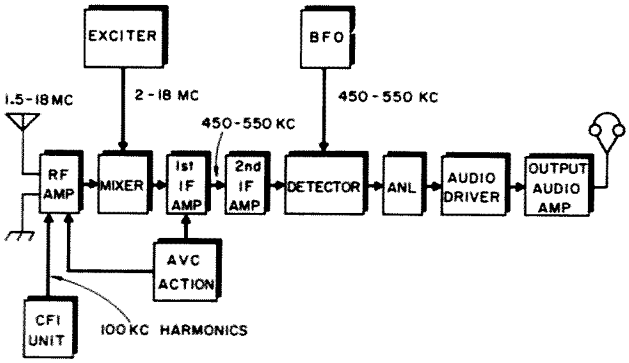
Arlington, Virginia

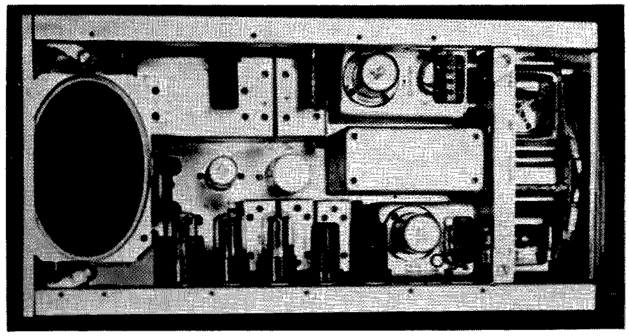
Possibly the best buy on today's surplus market is the Collin's R-105A/ARR-15 or 51H3 high frequency aircraft receiver. It is a modern, 14 tube, single conversion superheterodyne receiver with one rf stage and two *if* stages. Frequency coverage is 1.5 to 18.5 mc in six bands. The receiver operates with a dynamotor from the usual 28 volt aircraft supply. The unit measures 7⅞" x 10⅜" x 21 9/16" and weighs 39 pounds.

The receiver, except for the loudspeaker, is completely self contained and all of the required operating controls appear on the front panel. The equipment may be operated from a remote position and a 10 channel autotune system is incorporated for this purpose. Ten frequencies may be manually selected and the autotune controls locked. These frequencies may then be selected by the motor driven system by operating the selector switch on the front panel or at a

Top: Before
Middle: During
Bottom: After



Block diagram of ARR15.



Details of speaker mounting, pilot light support and the stripped down autotune heads are shown here.

remote position. The autotune system is removed in this conversion since I had no use for this feature. Also, it was desired to reduce the loading on the manual tuning controls and the space gained by its removal makes the conversion easier.

Major features include the use of two Collins PTO units in the BFO and in the conversion oscillator spots. The front end 70E-2 PTO is ganged to the usual Collins slug rack which tunes the front end stages. The 70E-2 BFO PTO is ganged to a second slug rack which tunes the *if* stages across a 100 kc band. The nominal *if* frequency is 500 kc, adjustable ±50 kc. This feature was used in the original circuit to generate a calibration signal that, in conjunction with the 100 kc CFI unit, enabled the front end circuits to be set precisely to the desired operating frequency. The calibration circuitry is quite elaborate and produces frequency meter accuracy. Fig. 1 shows the system better than words. It is obvious that this feature could be used as a variable frequency *if* system and provision is made for this in the conversion.

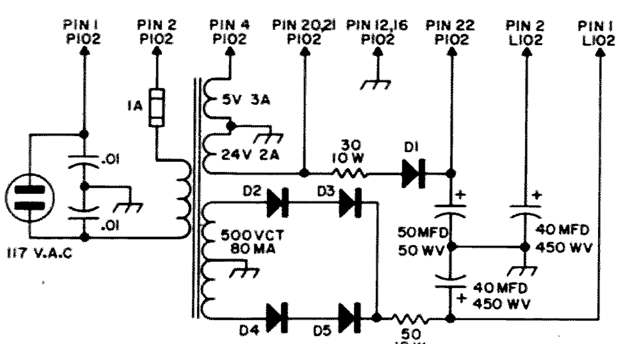
The heart of the receiver is the front end PTO which covers a range of 2.0 to 3.0 mc in ten linearly calibrated revolutions. This unit drives a frequency multiplier stage, the output of which is used in the mixer. The PTO is geared to the slug rack which tunes the frequency multiplier, the rf amplifier and the mixer grid circuits. Frequency relationships existing for the various bands are as follows:

Band	Frequency Range (mc)	HF Osc Freq (mc)	Injection Freq (mc)	Received Frequency Compared to Injection Frequency (mc)
A	1.5- 2.5	2-3	2- 3	−0.5
B	2.5- 3.5	2-3	2- 3	+0.5
C	3.5- 5.5	2-3	4- 6	−0.5
D	5.5- 8.5	2-3	6- 9	−0.5
E	8.5-12.5	2-3	8-12	+0.5
F	12.5-18.5	2-3	12-18	+0.5

The conversion of the receiver can be as simple or as elaborate as is desired. The basic conversion involves removal of the dynamotor and substitution of ac plate, 24 volt ac filament and 24 volt dc supplies. The autotune system is completely removed and suitable tuning controls extended to the front panel. Certain switching functions which were accomplished by the one CW-AM control have been broken out on separate switches for greater flexibility. The same is true of the audio and rf gain controls.

Some of the considerations which brought about the conversion in its present form may not be apparent at first glance and a brief discussion of the more salient points is probably in order. The calibration or CFI unit is controlled by a relay which removes and grounds the antenna, applies power to the unit and connects the output to the receiver input. The relay is controlled by a microswitch which is actuated when the BFO is tuned away from the 500 kc detent. I removed this switch and installed a toggle switch.

The gain control consists of a T-pad in the audio output circuit which is ganged to the usual rf gain control in the cathodes of the



Power supply.

rf and *if* stages. A separate rf gain control is installed and an audio control installed at the input of the audio amplifier. Delayed AGC is used in both the AM and CW modes, although partial control of AGC action is obtained by switching in additional delay voltage in the CW mode position. This feature is not disturbed since its deactivation is not worth the effort. Instead, an AGC ON-OFF switch is added which grounds the AGC line in the OFF position. A very effective noise limiter circuit is provided. Original plans called for a defeat switch to reduce audio distortion when the limiter was not required. However, the limiter is self adjusting and the clipping level rides above the level of the received signal. No appreciable distortion is introduced by leaving it in the circuit.

A low pass-band pass filter is included between the audio driver and output stages. A relay is mounted in the filter can and the original mode switch is wired to switch the filter to the band pass condition in the CW position. This feature is retained and a audio filter IN-OUT switch is installed to permit independent control of the filter. The audio gain is a bit low, since the receiver is designed to drive low impedance headsets. Use of a 1 megohm gain control in the first audio stage grid instead of the 470,000 ohm resister used in the original circuit picks up some gain. 20 uf cathode bypass capacitors in both the driver and the output stage provide all the gain increase that is required. The existing 7,000 to 300 ohm audio output transformer is retained and wired to a new, normal through, front panel phone jack. A 4" x 6" PM loudspeaker is in the rear of the former dynamotor well and a line matching transformer is installed on the speaker frame.

The first step in the conversion is to remove the dynamotor and its filter box and to reinstall such of the hardware as will be required in the finished conversion. Loosen the single turn fastener at the rear of the case and remove from the chassis. Remove the screws that secure the "X" member to the top of the chassis and discard the stamping along with the hardware. Loosen the dynamotor retaining clips, unplug and discard the unit. Unplug J 109 from P 102 which is mounted on the side of the dynamotor filter box. Clip the lead connected to terminal at 1 of L 102 at the point where it terminates at the end of the filter box. Remove the screws which hold the box in place and remove the box. Remove the cover to the box and strip out all components. Saw a rectangle from the side of the box which mounted P 102 and dress the edges smooth. Clean up P 102, placing it in its original orientation, inside the chassis. Place the plate on the outside of the chassis, over the cutout, and install the original mounting screws, through the plate and chassis cutout and into the tapped holes in the body of P 102. From the other side of the filter box, cut an "L" shaped bracket to just fit in the open space at the end of the chassis which was occupied by the old P 101. Mount this bracket in place with a couple of screws, approximately ⅝" in from the end of the chassis. Mount a male AC receptacle and a fuse post on this bracket, making sure that clearance is maintained for the walls of the connector cutout in the back of the case. The work is easier than it sounds and the photographs explain it better than words. Discard the remains of the filter box and all the components which were mounted in it.

The front end of the receiver next receives attention. Stand the unit face up, remove and discard the front panel handles. Remove the clip which secures the coaxial cable to the antenna post and pull the cable free. Remove the dial light switch retaining nut, all the knobs and dust-proofing hardware, the Autotune locking screws and the antenna connector assembly, discarding the works. Remove and retain the front panel. Position the BFO dial at the "O" or detent position, set the band change switch to the center of a band position and set the frequency dial exactly to a dial division. Using masking tape, fasten the scales together so that their relative position will not be changed. Remove and save the retaining rings on each dial shaft and the hardware which holds the dial pointers. Very carefully remove the dial assemblies and set them aside. Carefully mark the position of the gears at the rear of the Autotune units and DO NOT CHANGE THE POSITIONS OF THE GEARS WHICH DRIVE THE INTERNAL TUNING ELEMENTS OF THE SET!

Remove the cover of the Autotune assembly, O 147; remove the screws which secure it to the casting and discard the entire unit. Remove the screws that secure J 112 to the casting, clip all leads connected to it and discard the receptacle. Remove the cover of relay K 102 and the screws which secure it to the casting. Clip the attached leads and discard the unit. Clip the leads attached to the calibrate control switch, S 103, remove the "C" washer that secures its actuating lever and remove the switch mounting hardware. Discard the complete assembly. Unplug receptacle, J 110 from the plug, P 103. Clip all leads attached to the plug which is mounted on the Autotune casting. Remove the plug and, after carefully cleaning it up, reinstall and attach J 110.

Remove the cover on the CFI unit to give access to the Autotune motor mounting screws. Remove these screws and reinstall the CFI unit cover. Clip the leads attached to the motor, pilot light switch and pilot light assembly, discarding everything except the lamps and mounting bracket. Remove the sub-panel which mounts J 111, R 139, R 144, S 104 and S 105. Clip all leads attached to these components and discard the complete assembly. Remove the standoff posts which mounted the subpanel, retaining one of them to remount the pilot light bracket. The wiring harness which wired all components in front of the Autotune casting is now free and may be removed and discarded.

Remove the three screws which mount each of the two Autotune heads, remove the units and set them aside. Carefully saw off the line shaft and line shaft gear drive mounting brackets flush with the other protrusions from the Autotune casting. Remove and discard the complete line drive assembly. Dress down the saw cuts with a file and very carefully remove the filings.

The Autotune heads are next on the agenda. The objective is to retain the dial mounting hardware as a support for the dials and the through shafts which couple the front panel knobs to the internal mechanism of the set. On the other hand, such portions of the assembles that can be removed should be to reduce friction in the manual drive. First to be removed should be the vernier drive shaft on the rf tuning head. This vernier drive has too much backlash to be of any value. The next step is to remove and discard the sheet metal covers of the units. From this point, you are on your own. This entire issue of 73 Magazine would be required to describe in detail the intricacies of these devices. Keep the objectives in mind and start stripping. The photographs show about how far you can go. To say the least, you will end up with a marvelous collection of strangely shaped, stainless steel hardware. When the stripped down units pass inspection, remount them in their original position. Reinstall the dials and the associated hardware. Rotate the dials through their range and insure that gear alignment, dial readings and slug rack positions are all as before the units were removed.

Attach a 300 ohm to 3 ohm line matching transformer

to the speaker and temporarily mount the unit to the rear chassis lip as shown in the photographs. Next, arrange the various power supply components, as shown in the photo, on the deck of the dynamotor well. Filter capacitor, C 144 is removed and mounting hole may be enlarged for a twist-tab electrolytic capacitor. In the parts layout, make certain there is no conflict with the speaker frame or output transformer. The Fair #818 power transformer is highly recommended. Aside from furnishing the required voltages, its compact construction and ease of mounting make it ideal. It is one of a line of power transformers specifically designed for surplus conversions and is available from Fair Radio Sales Company, 2133 Elida Road, P.O. Box 1105, Lima, Ohio.

Drill and cut a new face panel using the old panel as a guide. Temporarily assemble the "sandwich" of the old and new panels. Remove the screws which mount S 102 and let the switch hang from its leads. Fasten the panel to the chassis, using ¼" screws in the old, right hand handle mounting holes. Holes for the new, shorting type phone jack and the vertical row of toggle switches should now be laid out and drilled. Drill a ⅜" hole in the location of the bottom, left hand handle mounting hole for the phone jack. Drill a ½" in the location of S 102. Lay out and drill one more ½" switch hole below and three more above this hole on 1 3/16" centers.

If desired, a vernier drive may be installed on the main tuning shaft as shown in the photographs. A 5 to 1 reduction unit with 360° dial was attached to the shaft and supported by the front panel.

Remove the panels, take them apart and clean up the rough edges and paint. When dry, reassemble the panels and mount on the chassis frame, using the component bushings and the previously mentioned ¼" screws. Mount the rf and audio gain controls in the holes provided. If standard ¼" shaft knobs are used, they will have to be modified to fit the odd size shafts used in the Autotune. The BFO shaft will have to be bushed out to ¼" diameter and the band switch and rf tuning knobs drilled out to fit the shafts.

The antenna connection is brought out the rear of the receiver to a coax jack through shielded cable. Punch some holes for ventilation.

1. Mount one of the former sub-panel mounting posts in the top center Autotune motor mounting hole. Saw the angle bracket of the pilot light assembly off flush with the socket mounting plate. Position the lights behind the dial scales, drill a hole and mount the assembly to the post. Connect the hot terminal to pin 11, P 103.
2. Attach the line matching transformer to the speaker and wire the secondary to the voice coil. Ground one side of the 300 ohm wiring. Mount the speaker and extend the hot lead to pin 14, P 102.
3. Transfer the leads from each section of S 102 to the new toggle switches, running a ground jumper between the phone jack and the AGC, Calibrate and BFO switches.
4. Remove the lead on pin 23, on the back of J 110 and connect to the terminal post marked E 102.
5. Run a two conductor shielded cable between the audio gain control and the vicinity of V 107, using existing cable clamps. It replaces R-151, 470K. The high terminal goes to C-134, .01 μf capacitor. The center goes to pin 4 of V 107 and the bottom is grounded.
6. Connect a 10 K ww vrf gain control between pins 17 and 18, P 103.
7. Connect jumpers on the pins of P 102 as follows: Chassis Ground to 12 and 16; 11 to 15; 20 to 21.
8. Connect jumpers on the pins of P 103 as follows: 1 to 22; 2 to 16; 12 to 18; 13 to 20; 14 to 15.

Check the work to insure that no wiring errors have been made. Silicon diodes can easily be destroyed before the line fuse blows. Use an ohmmeter and check for B+ shorts. If all seems well, plug it in. Advance the rf and audio gain controls and you should be in business. If the audio gain is insufficient for your requirements, connect 25 μf capacitors from pin 6 of V-107 to ground and from pin 8 of V-108 to ground.

A check on the calibration and alignment will probably show them to be slightly off. Remove the connector from P 301 on the high frequency PTO, turn on the BFO and Calibrate switches and advance the gain controls all the way. Set the BFO knob for zero beat, then loosen the gear that drives the dial scale and set it to "0" and tighten the set screws. With the dial still set at "0," reconnect the HF PTO, tune in a steady signal and adjust the six screws on the *if* slug rack for maximum output. Turn the band switch to band "A" and set the dial for zero beat with a 100 kc checkpoint. Loosen the coupling on the HF PTO and set the dial pointer precisely on the 100 kc calibration marker and retighten the coupling. Tune in a steady signal in the section of each band where maximum performance is desired and adjust the HF slug rack screws marked with the designation of the particular band. Adjust for maximum output and on bands "B," "E" and "F" touch up the trimmers on the right side of the chassis.

Two operating options are available with this receiver. The BFO may be tuned to the center of its range and all tuning accomplished with the front end tuning control or the HF tuning may be used only to set to zero beat with 100 kc check points and the BFO-*if* tuned across 100 kc bands. On bands "A" and "B," one revolution of the front end PTO shaft covers 100 kc. Calibration is accurate to within one or two kilocycles across the entire band. Equal accuracy and comparable stability exists on the higher bands but, since harmonics of the PTO are used, the dial may not be read as accurately. No deterioration of performance was noted when the front end is set on the check points and the *if* tuned. If this mode is to be used, the dial calibrations on the BFO scale will prove confusing. Two scales are provided to compensate for the fact that, depending on the band in use, the conversion frequency may be above or below the received singal. The scales are calibrated 50-0-100-50 and 50-100-0-50, with a dial mask geared to the bandswitch selecting the proper scale. In the original application the BFO was offset and the HF oscillator tuned to zero beat and the BFO then returned to "O." This results in the dial scales being reversed when the *if* is tuned. Perhaps the best answer is to remove the mask and to mentally select the proper scale for the band in use.

. . . W4WKM

If you'd like a schematic of the whole ARR15, 73 can supply one for 50¢. 73 Magazine, Peterborough, N. H.

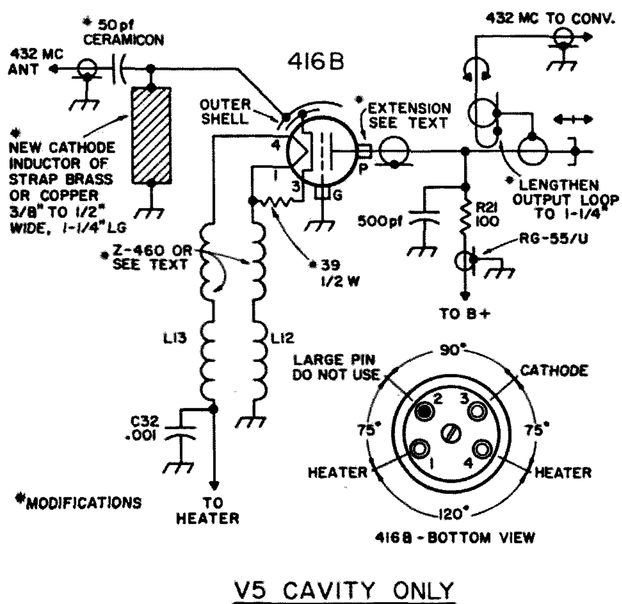
Leroy May, W5AJG
9428 Hobart St.
Dallas, Texas 75218

432 mc Preamplifier from the TD-2

Several articles published in *73 Magazine**, show the conversion information to enable one to change over to the WE planar triode 416B type tube for improved operation on 432 mc and 220 mc. Since the original efforts produced very good results other suitable pieces and parts of equipment that lend themselves very handily to the same process have turned up.

Many configurations of tank circuits around the 400 to 600 mc range of frequencies were used in both WWII and postwar equipments with such lighthouse tubes as 446A/B, 2C40, 2C43, 2C46, etc. In most cases, the dimensions of such tubes are such that the WE 416B gold plated triode can be adapted to the existing structures without too much difficulty.

This article will describe such a piece of equipment. It is a coaxial section of cavity contained in the surplus telephone company TD-2 microwave generator set. The TD-2 is now in surplus at a very attractive price (around $20.00) and is a valuable addition in parts alone for the VHF-UHF man. Various cavities that cross 1296 mc can possibly be salvaged along with many other useful items.



V5 CAVITY ONLY

Modified preamplifier.

The unmodified TD-2 generator starts with 17.5 to 19 mc crystals (VI) and progresses along the multiplier string which uses six more tubes (V2 thru V7) to reach the desired output of around 4,000 mc. Stages number 4 and 5 use 2C43 tubes and stages number 6 and 7 use 416B's. This TD-2 generator appears to have promise on 1296 mc and also possible use at its normal output frequency range of 4,000 mc as a pump source for paramps.

The cavity we're after is a quarter wavelength section of coaxial cavity associated with tube V5 and marked ED63913-30G1. This is one of the frequency multipliers and in its present form operates as a tripler from 208—211.2 mc to 624—633.6 mc. This is the cavity we shall modify as a straight through rf preamplifier for 432 mc.

Changes are rather simple and usually take only an hour or so to perform. Operation is surefire. There is really nothing much to go wrong with it. As in the previous conversions of equipments to use the 416B tube, this one will follow similar lines, that is, a few simple mechanical changes plus lowered plate and heater voltage to allow operation of the 416B tube without external air blowing on the seals.

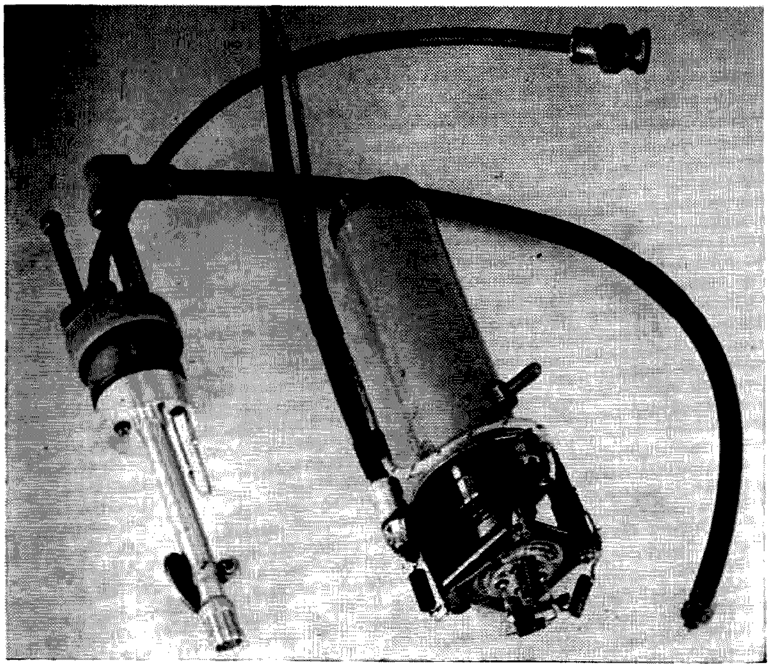
Modifications

If possible, read the previous instructions contained in the reference articles, then proceed.

Since the cathode input circuit will no longer be operating at the 208 mc range, remove the coil L7 and capacitor C-9. In their place fashion a broadly resonant 432 mc copper strap inductor about 1-¼" long and ⅜ or ½" wide. Form it between the grounded grid ring assembly and the square rf cathode plate structure. Refer to the photograph and sketches. The antenna is tapped directly to this rf cathode structure through a 50 pf ceramicon capacitor. The original rf chokes are left in

*"Using the 416B and 8058 Tubes as 432 mc Preamplifiers in the Navy CFN-46ADT Converter," 73, June 1964.

"Using the 416B on 220 mc with the Navy CG-50ABN Preamplifier," page 52 this issue.



Exploded view of the modified V5 cavity from the Tell Co TD-2, 4000 Mc generator. The insides screw into the cylinder. The input antenna coax is the one taped to the heater line. It terminates on the round grid ring and the inner connection goes to the series ceramicon capacitor, thence to the square cathode plate. The heater and cathode rf chokes may be seen as well as the cathode resistor. These components are slipped on to the 416B tube prongs with retrieved tube socket clips. The plate voltage is through the coax cable with the BNC connector on the end. The added circular disc is seen strapped to the inner conductor of the cavity up near the plate finger receptacle. The mating disc terminates in a screw driver adjusted screw in the outer wall of the cylinder cavity. Output coupling link is lengthened and can be seen quite clearly where it has been soldered to make the extension. Output rf signal is contained through the coax with the end open.

place, but two new ones are also added. Use Ohmite Z-460 units or about 13 turns of No. 22 enameled wire close wound on an ⅛" form (about .2 μh.)

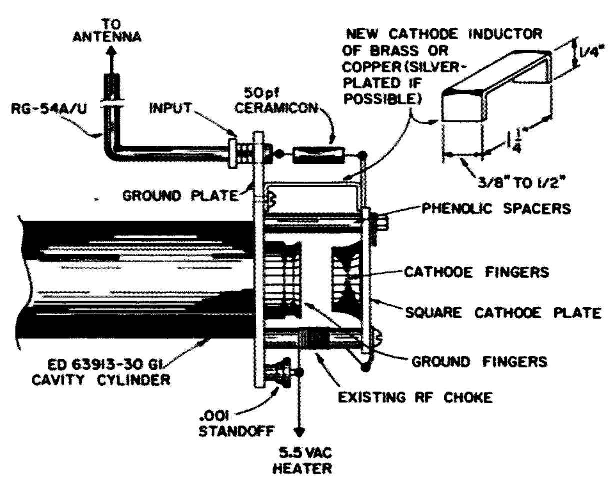
The original plate circuit is resonant at around 600 mc, so it will be necessary to bring down the frequency a bit. This can be done by adding a circular plate about ⅞" in diameter close to the plate end of the line. It may be secured to the inner conductor by a strap or by any other way you like. Arrange for a matching circular plate to mesh with the fixed plate. The wall thickness of the outer cylinder of the cavity is sufficient to thread for this variable plate. These small circular discs are plentiful items in most 432 mc junk boxes. The two discs may be left quite close together and the final tuning done with the original tuning screw which adjusts the shortening fingers inside the cavity or the tuning may be done with the variable circular disc. Suit yourself.

The plate line will not quite reach the plate connection of a 416B tube, since the 2C43 is slightly longer. It will be necessary to provide an extension. Using a piece of ¼" copper tubing about ¾" long, slit one end with a hacksaw and adjust the tension to accept the plate cap of the 416B. The other end of the tubing will now fit perfectly into the plate fingers that formerly engaged the cap of the 2C43 tube if the fingers are bent inwards just a bit.

The output coupling loop should be lengthened to about 1-¼" long or just about double the original length to increase the loading of the tube. Just form and solder on a length of bare tinned or silvered copper wire for this. The photograph shows this clearly.

The rf input from the antenna terminates in the unused "ear" projection of the ground disc. The inner conductor connects to the series ceramicon capacitor, thence to the cathode square plate. The existing couple of small tabs serve to hold the 416B tube firmly down.

Taped to the antenna coax input cable will be seen the heater line carrying the desired 5.0 to 5.5 vac. The plate voltage may be anything from 70 to 105 volts, preferably regulated. The plate current will be from 4 to 7 ma, according to the condition of the individual 416B tube used. The plate voltage arrives via the RG-55/U piece of coax with a BNC type plug on its end. This may be modified for anything you desire. It was left as is here at W5AJG.



Modified TD-2 cavity.

The tuning lead screw may be seen adjacent to this B plus lead. Here is where tuning adjustments are best made. The rf output that will go to the input of the 432 mc converter is the larger coax cable, type RG-54A/U. If you use UHF or type N plugs, connect on the end of this cable.

The cathode resistor is a 39 ohm unit which replaces the original 1500 ohm (R-8) one and this component as well as the heater leads are clipped on to the prongs of the 416B tube with tube socket clips.

Since the diameter of the grid ring of the 416B is of the same approximate diameter as the grid ring of the 2C43, perfect fit is obtained and very effective grounding is secured for the new tube. The cathode securing fingers on the underside of the square cathode plate may be bent inwards a bit and thus a secure fit will be obtained on this element of the 416B, which is ⅞" in diameter as contrasted to 1" in diameter for the 2C43 tube.

Operation

Little need be said here. Voltages are set, connections to the antenna and input of the 432 converter are then made and the unit tuned to frequency with the circular tuning plate. A signal generator will be useful at this point, but lacking that, a 432 signal or even a bit of ignition noise may be employed. After the tuning disc is locked down, the lead screw at the rear of the cavity may be used to peak the frequency.

As has been expounded in the several articles regarding the proper tuning of such pre-amplifiers as this, an out of town weak signal is the best one can do, short of professional test gear. Nothing will take the place of a 432 mc buddy some couple of hundred miles who will put on his "V" wheel and let you have at it for a few minutes each day. This practice is universal around this area among the UHF boys and it is highly recommended. By alternately using the pre-amplifier and then going around it, one can tell very quickly if the score is favorable.

Some workers have stated that a small variable employed in place of the fixed 50 pf ceramicon as shown here was used to advantage. No improvement could be noted at this location, but it is certainly worth a try if you are so inclined.

No bragging will be done to finish off this writing. Four different types of 432 pre-amplifiers have been and are being used here at W5AJG, three using 416B tubes and one using 8058 Nuvistors. All give equally good results—by good results is meant a definite improvement in S/N ratio over not using them at all. As far as a statement about an absolute improvement in noise figure is concerned, this is beyond our capability at this time. After all, one might have a fantastically low noise figure (perhaps by accident) but be burdened with a questionable antenna or a rather poor uhf location and not even hear signals his good friend across town hears with just so-so receiving gear.

Quite often I find myself thinking that I am the unfortunate one. Don't we all?

. . .W5AJG

VHF

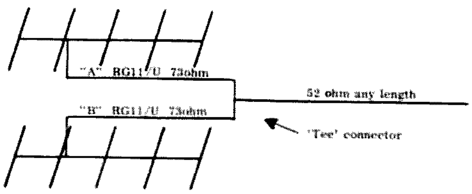
In the May column I said we would discuss antenna stacking and matching this month. Refer to that column for a coaxial feedline loss chart.

Placing two identical antennas side by side, or one above the other, will increase the gain over a single beam by 3 db, the same as doubling your transmitted power. This increase also applies to receiving.

In other words, if a single beam has 10 db gain, stacking two of them would yield 13 db and four beams in a quad would bring the gain to 16 db.

The longer the boom, the further it should be stacked for proper operation. Two four element two meter beams should be separated 82"; six elements, 107"; eight elements, 120" and ten element beams 132". So you can see there is no precise stacking distance. It depends on boom length and the number of elements.

There is an easy way to stack two 52 ohm antennas,



Length of "A" and "B" in inches

Freq:	5/4w	7/4w	9/4w
144 mc	67.5	94.5	121.5
145 mc	67.0	93.8	120.6
146 mc	66.5	93.1	119.7
147 mc	66.0	92.4	118.8
148 mc	65.5	91.7	117.9

"w" is wavelength

using 73 ohm coax. Below is a diagram and the mechanical lengths of the coax. Do not alter the lengths. The velocity factor of the coax has already been considered.

You will note the 73 ohm harnesses are in odd multiples of ¼ wave-lengths. If other than these figures are used the linear transformer will not properly reduce the input to 52 ohms.

Since this harness allows any two identical 52 ohm antennas to be fed with a single 52 ohm line, it is obvious another harness in exactly the same manner would feed four antennas each connected by a single harness to a final harness. If you do stack antennas, be SURE that the braid of each feeder goes to the same side of each antenna or you will have a pattern that can't be found in any handbook!

We have purposely used two meters but the arrangement holds true for any frequency if the feeders are cut proportionately.

(Tnx W9HOV; Gain, Inc.)

The Midwest VHF Meeting, held in Sioux Falls, South Dakota brought in over 80 VHF'ers from both Dakotas, Minnesota, Iowa, Nebraska, Illinois, Michigan and Canada.

Featured speakers were Sam Harris W1BU/W1FZJ; Bill Roberts W9HOV; Clarence Hunter of Galaxy Electronics (they will begin marketing a 6 and 2 meter full-coverage, SSB, CW and AM transistorized transceiver in August: Write Alan McMillan at WRL for details) and Charles Compton WØBUO, Dakota Division Director of the ARRL.

I hope this get-together will not die and that another midwest group will consider a similar meeting for next year.

Please send in your short articles, circuits and so forth. If you will send them to me directly we can avoid a delay in getting them into print.

. . . KØCER

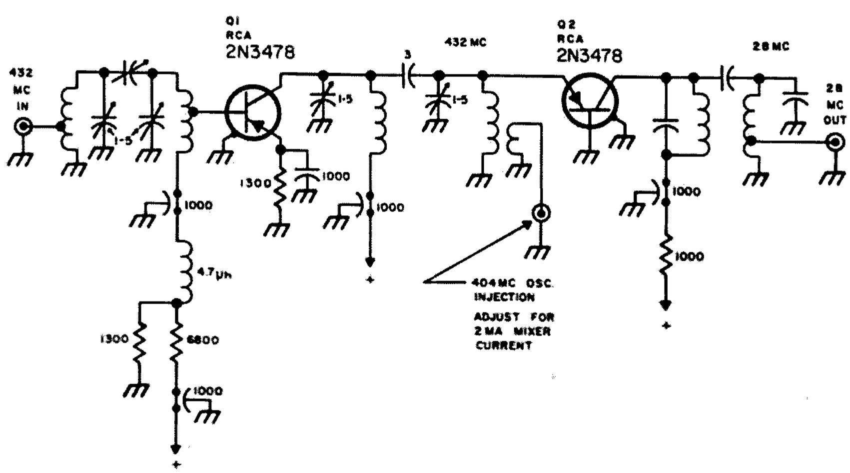
SEMICONDUCTORS

The biggest news in semiconductors this month is the RCA 2N3478. This $2 transistor is the hottest thing you'll find for 432 mc. W1OOP first mentioned it, then a trip to W1BU really convinced me. Sam has a single 2N3478 mixer with a 7 *db* noise figure. Compare that with complete tube-type converters: one of the best that Sam has seen uses a couple of $14 8058 rf stages plus mixer in a complex, space-consuming, power-hungry converter. It has a NF of 7.5 db. A 2N3478 mixer alone will beat that and give you a simple converter to get going on 432 mc. Adding a 2N3478 rf amplifier brings the noise figure down to 4 db. You won't beat that unless you use a parametric amplifier as Sam does.

A few notes on the converter. The mixer is in grounded base class C. It draws no current unless you apply local injection or a strong signal to it. Adjust the injection for about 2 ma collector current with no signal. The version shown uses double-tuned circuits in case you have UHF neighbors. You can use simple coils if you live in the sticks, or coaxial circuits if you live in Medfield. Thanks to W1BU; I traced the circuit from one of his converters. I'm building my own now and will let you know how it turns out.

The Fairchild line of inexpensive silicon transsistors, like others discussed last month, is ideal for ham and commercial applications. They have transistors for all uses. A number of hams have tried them out with excellent results. A good example is the PNP 2N3638. It's billed as a 2N404 replacement at the same price—46c. But it's silicon rather than germanium, so offers many advantages over the 2N404: heat resistance, electrical toughness, more uniform characteristics. This transistor is an excellent general purpose unit. You can use it for switching and logic circuits (as in electronic keys), audio and even low level rf. Another Fairchild transistor is the 2N3635 for audio use, but K1MFQ even uses one as a varactor to get local injection for 432 mc converters. We hope to hear more from him on that.

K8AOE writes that he has been using the inexpensive Texas Instruments TIXM05, 6 and 7 (mentioned last month) in grounded base converters for 6 and 2. He's very happy; noise generator comparisons indicated that his converter is better than a well-known commercial converter on 2.



K8ERV asks for single quantity prices. I'll give them when I can find them. But there's usually no more than a 2 to 1 spread between single prices and 10,000-quantity prices. If the quantity price is $1, you shouldn't have to pay more than $2 or so.

Next month I'll discuss the parameters manufacturers use in rating transistors. Until then, don't forget to write. We're particularly interested in what transistors you've been using and what results you've had.

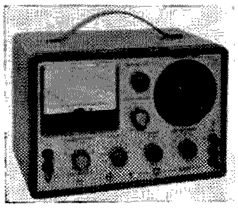
Paul Franson WA1CCH
73 Magazine
Peterborough, N. H.

New Products

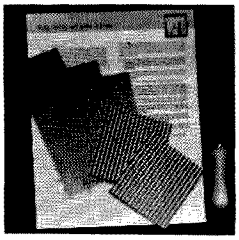
New Skylane Quad

Skylane Products has introduced a new member to their excellent line of quads. The new quad is a four element array that boasts many advantages over quads with fewer elements; it features greater gain, better F/B ratio and a much sharper horizontal field pattern. Input impedance is approximately the same as the three element quad. The SWR is less than 2 to 1 at any place in any band for which the quad is designed and is approximately 1-1 at resonance . . . in other words, just what might be expected by adding another element to the already famous Skylane three element quad. Write for new catalog with complete information from Skylane Products, 406 Bon Air Drive, Temple Terrace, Florida.

EICO Bridge Analyzer



EICO has a new one-instrument lab that does about everything possible in a lab. It's called the 965 FaradOhm Bridge-Analyzer. Among its uses: R-C bridge, R-C-L comparator, capacitance leakage/I-R analyzer, a DC VTVM and a DC nano-micro-milliameter. This one will do the work of many other instruments for the lab, experimenter or serviceman. It's available wired and tested for $129.95. Write EICO, 131-01 39th Ave., Flushing, N. Y. for more details.



Low Priced Veroboard Kit

Vero Electronics has an interesting new product, the Veroboard Breadboard Kit BK-6. This kit consists of six assorted Veroboard Universal wiring boards, a Vero spot face cutter and complete instructions on how to design a component layout directly on this unique new wiring board. With a Veroboard, you don't need a chassis, bracket, terminals, tools or wires. The basic construction kit is all you need to breadboard experimental circuits or make a finished circuit board. The Veroboard Breadboard kit BK-6 is available from Vero Electronics, 48 Allen Blvd., Farmingdale, N. Y., for $5.95 delivered.

More Letters

Dear Wayne:

I suppose I'm what you would call an old-timer among hams. Whenever possible I've built most of my own gear in the past; and I still do. To me, this means a grand part of amateur radio . . . rolling your own, experimenting with different circuits, modifying, up-dating your own station. Plus a kind word to the new ham in our midst, along with a few spare parts.

But I obviously cannot afford to pay "list price" for everything that finds it way into my shack. And so we economize, while not sacrificing quality, by utilizing "surplus" gear and parts whenever they will fit the need. I've been buying surplus from Meshna up Boston way, and Rex in New York for many years, with complete satisfaction.

But we find that the "official" publication of the hams won't take ads from these people . . . despite their favorable reputation. And it becomes quite obvious that subscribers to that magazine are being diverted from buying what they want, because of this selective policy. No ads from the "surplus houses" are allowed, but you can bet your boots that there are plenty for ready-made equipment.

But when the managers of this staid journal paid money—real money, an exceptional occasion—to writers and one man lambasted the art of do-it-yourself, while no one presented the opposite side of the coin, this caused me to stop and think: where are we drifting? Or better stated: where are these managers trying to manipulate us??

It would seem toward the realm of buy-it, plug it in, and yak it up. Should this continue unchanged, we amateurs will have no more respect from the regulatory authorities than the citizen-band operators, and justifiably so. This is one aspect of amateur radio that I would certainly like to see revived and revitalized: the gentle art of make-it-yourself! Even when you fail in a project of this nature, you must learn something. And when you do make it, there is a terrific sense of pride in completion of your own work.

Keep up the steady stream of thoughtful articles that you have been providing. I find your magazine most helpful and informative in matters of this nature. It often furnishes a ray of hope in an otherwise somber picture. The arrival of 73 each and every month is an appreciated event at the W2OLU ham-shack.

Neil Johnson W2OLU

Dear Wayne,

I read with interest the excellent and informative article by K2ICF/6 on the double Hula hoop antenna. It didn't take long for somebody to realize that the ground plane could be eliminated in this way. There are a couple of points which may contribute to an even better version of this antenna, and I'd like to put in my nickel's worth.

In feeding this antenna, if one uses an open wire tuned feed system (a la Zepp antenna) connected to the ends of the hoops, two major advantages will appear.

1. Resonating the ring will now be a matter of tuning a coupling circuit which can be located inside the shack, so easy QSY becomes possible.

2. Because the tuned feed system can reflect an inductive as well as a capacitive load across the ends of the antenna, it no longer becomes necessary to cut the loops for the high end of the band, as with capacitive tuning alone. Possible operation on harmonic frequencies, and certainly operation on frequencies where the circumference of the hoops exceeds a quarter wave should be practical, and perhaps very interesting.

Best regards,
Henry S. Keen W2CTK

Dear Wayne:

On page 15 of May 73 magazine, how does the receiver work without an antenna? HI. May I suggest removing the antenna lead from the first terminal down and connecting it to fourth terminal down.

Cliff Rowe W2CTH

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NORTHEAST OHIO VHF hamfest Sunday June 20th at Maca Park two miles east of Tallmadge, Ohio on state route 18. Lots of prizes and contests. Contact W8JHS, W8CZV or W8IXZ for more information.

TOTAH ARC field day. June 19 and 20. Work the station and get the 507 award. Totah ARC, P. O. Box 24, Farmington, N. M.

MID-MO ARC hamfest. June 5, Memorial Park in Jefferson City, Mo. Contact KØJJS, 1204 Edgewood Drive for more information.

TRI-STATE ARC Ham picnic, June 6 at Camden Park in Huntington, W. Va.

CLARK COUNTY hamfest. June 13 at the Clark Co. State Forest near Henryville, Indiana.

NATIONAL CAPITAL VHF Hamfest, May 23rd at Marshall Hall Park in Charles County, Md.

CLINTON COUNTY VHF hamfest. June 13 at Shady Acres Ranch near Frankfort, Ind. Contact W9URS for more information.

BREEZESHOOTERS HAMFEST. May 23 at West View Park near Pittsburgh, Pa.
View Park near Pittsburg, Pa.

KW WARRIOR linear amplifier. $150. DX-100 $99. Add for crating. Will ship REA collect. Phone 201-747-1090. W2QND, 176 Winding Way South, Little Silver, N. J.

WANTED: Miscellaneous units and manual or schematics for Navy transmitters AN/SRT14, 15 or 16. Also unmodified prop pitch motors. John McDermott, Box 8, Stratford, Conn.

DRAKE 2B: 20 hours use. Must sell to settle estate. First check for $175 takes it. Les Grinspoon W3BDE, 1900 Lyttonsville Rd., Silver Spring, Md.

WANT SX-71 or similar receiver, Q-multiplier. For sale or trade 80 meter loading coil for Hy-Gain 14-AVS vertical, $5. Maurice Blais K1FHD Box 396, Derby Line, Vt.

ANGER II with PTT. Immaculate. 6-160 meters, $185. rake RV-3 new unused, $55. AR-22 rotor, $20. 254C urner mike, $10. Matched set 12JB6 tubes for TR-3, $6. V6EUF, 2301 Canehill, Long Beach, Calif.

OMPLETE MOBILE RIG: Gonset G66 receiver 10 rough BC, AM/CW/SSB. Gonset G77 transmitter 10 rough 80 AM/CW. Transistorized power supply and odulator. Tri-band antenna, Shure mike, Burglar alarm. 199. Bert Green W2LPC, 51 Elmira St., Hicksville, N. Y.

REE! Blue Book List. Leo offers hundreds of bargains n reconditioned gear. Viking II $97.70; SC117 $289.00; ollins 62S-1 $598.50; King 500A $259.00; Galaxy 300 239.00; Heath MR1 $59.46; HQ140X $139.00; Cheynne $49.18; SX-140 $72.15; SX-101A $229.00; SX71 99.00—Many more. Free 1965 Catalog. WRL, WØGFQ, ox 919, Council Bluffs, Iowa.

OROIDS: Assorted new toroid coils 10 for $1.00. Inlude 25c for postage and handling. R & R Electronics ept. 5J 1953 South Yellowsprings, Springfield, Ohio.

MPROVED Tape in Red, Blue or Black, letters emboss hite, for NAME-O-MATIC Machines, 10 feet 75c. Mahines $4.95, 50c shipping. Spitz, Box 4095, Arlington, irginia.

JSED SIMPSON 260 $25.; Precision 10-12 Tube ckr. 30.; E-400 RF Sweep Gen. $45; other items. Dave elage, Cos Cob, Conn. 203-869-2027.

AN FERNANDO VALLEY RADIO CLUB, W6SD, th Annual Hamfest-Picnic, July 11. Sunset Farms, 16303 oothill Blvd., San Fernando. Free Prizes, swimming, isplays. Write for info; WB6GZZ, c/o Box 3151, Van uys, Calif. 91407.

NWQCWA will hold its annual summer meeting in Seattle this year on June 12 and 13, at the Lakeshore Inn Motel. All old timers, whether members or not, will be welcome. For further information and reservations contact W. P. Gilbert W7QA, 4060 S. Myrtle St., Seattle, Washngton, 98118.

COLLINS KWM-1 & AC Supply 516F-1 $375. KWM-1, 516F-1, 12 VDC Supply 516E-1 & Mobile Mount 351D-1 $525. Joseph Lodato, 4519 Gen. Early, New Orleans, La. 70126.

HEATH TWO'ER, with Nuvistorized front end, spotting switch, tuning meter, 6 xtals, Viking 2mtr Vfo. $50 takes all. 213-447-4469, WA6MOW, 52 Birchcroft, Arcadia, Calif. 91006.

SB-33 with DC power supply $275, HT-33 Mark 1 $200, GPR-90 $225. All excellent. Cloyd Peters KØELU, Rt. 1, McCook, Neb.

ATTENTION AMATEURS: Beach QTH for rent. Completely furnished, permanent allband antennas affired, accommodates eight. Write for reservations. Herbert Branham WA4ICB, 861 Dill Bluff Road, Charleston, S. C.

WANTED-URGENT: Two sections of standard KTV-8 brace tower with hardware. KISCQ, 44 Parkway Crescent, Milton, Mass. Call 617-696-2575.

ATTENTION: Two letter call license plates needed to complete collection. Pre '57 Tennessee plates also needed. Proud to display any plate. Mike WA4QED. Milan, Tenn.

DX-100B, $125. Western Electric 34-A, $200. RCO, $25. S-39, $25. Concertone #1401, $75. Wanted schematic, controls BC-413-A. W6KEC, 154 N. McKinley Pl., Monrovia, Calif. 91016.

GLOBE HIGHBANDER and VFO, 6/2, $125.00. Tapetone 6m converter with P/S, $25.00. Near new D104C mike, $14.00. FOB. WA2DEW/KV4CQ, 372 Essex Ave., Bloomfield, N. J. 07003.

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This fabulous hardbound 540 page handbook completely and thoroughly covers every aspect of amateur radio: tubes, transistors, receivers, transmitters, VHF gear, antennas, sideband, FM, mobile gear, noise, power supplies and much, much more. This handbook is a necessity of the building ham. Published by the RSGB. $5.50

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417A Converter for 2
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Design of VHF Tank Circuits
2 m Transistorized Transceiver
Varactor Tripler to 1296
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QSL CARDS??? Samples 25¢ (refunded). Sakkers W8DED, Holland, Michigan. (mention "73").

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TUBES 4CX250B (7) @ $35; 417A (10) @ $3; 707 (10) @ $10; 6C21 $10; GL6442 (2) @ $20; Johnso Mobile $30. Tubes new. Getting married and have t forget VHF KW. K1GBF, Box 485, Manchester, Vermont.

73 Books

Peterborough, N.H.

-CARE AND FEEDING OF HAM LUBS—K9AMD.—Carole did a thor- igh research job on over a hundred am clubs to find out what aspects ent to make them successful and hat seemed to lead to their demise. is book tells all and will be in- luable to all club officers or any- e interested in forming a successful am club. **$1.00**

-SIMPLIFIED MATH FOR THE HAM- HACK—K8LFI.—This is the simplest d easiest to fathom explanation of hm's Law, squares, roots, powers, equency/meters, logs, slide rules, etc. our schools ever got wind of this nazing method of understanding ba- c math our kids would have a lot ss trouble. **50c**

-REVISED INDEX TO SURPLUS— '4WKM.—This is a complete list of ery article ever published on the onversion of surplus equipment. Gives brief rundown on the article and urce. Complete to date. **$1.50**

-SURPLUS TV SCHEMATICS.—You an save a lot of building time in TV you take advantage of the real argains in surplus. This book gives e circuit diagrams and info on the opularly available surplus TV gear. **$1.00**

7—AN/ARC-2 CONVERSION.—This transceiver sells in the surplus market for from $40 to $50 and is easily con- verted into a fine little ham trans- ceiver. Covers 2-9 mc (160-80-75-40 meters). This booklet gives you the complete schematics and detailed con- version instructions. **$1.00**

12—CW—W6SFM.—Anyone can learn the code. This book, by an expert, lays in a good foundation for later high speed CW ability. **50c**

14—MICKEY MIKER—WØOPA.—Com- plete instructions for building a simple precision capacity tester. Illustrated. **50c**

15—FREQUENCY MEASURINC—WØHKF—Ever want to set yourself up to measure frequency right down to the gnat's eyebrow? An expert lets you in on all of the secrets. Join Bob high up on the list of Frequency Measuring Test winners. **$1.00**

RECEIVERS. K5JKX.—If you want to build a receiver or to really under- stand your receiver, this is the book for you. It covers every aspect of receiving in author Kyles usual thor- ough manner. **$2.00**

ATV ANTHOLOGY. WØKYQ and WA4HWH.—A collection of the con- struction and technical articles from the ATV Experimenter. Includes o complete, easy to build vidicon cam- tra and 50 other projects. The only book available about ham TV. **$3.00**

PARAMETRIC AMPLIFIERS. WA6BSO.—Parametric amplifiers are probably the most practical way for hams to get a low noise figure at VHF and UHF. This book is the only one avail- able that covers both theory and prac- tice. **$2.00**

TEST EQUIPMENT HANDBOOK. W6VAT.—Every ham needs to have and know how to use test equipment. This book tells you how to make valu- able ham test gear easily and cheaply. It also covers the use of test equip- ment. **50c**

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BANDSWITCHING table top CW KW: Pair of 4-250A's with matching VFO exciter. Professional construction. Must be seen. $275. Dave Allen W1WAI, 9 Upland, Burlington, Mass.

POLY-COM 6 six meter transceiver for sale. Perfect—5 months old. $250. FOB. Write to WB2POI William Goebeler, 124 North Sixth Street, New Hyde Park, N. Y.

COMPLETE station, great for beginner. TBS-50D (50/65 watts), Elmac PMR-6A, Q multiplier, 6 meter converter, D-104 mike, AR-22 rotor, SWR meter, plus VFO's, power supplies, junk, etc. Everything you need but the antenna. $161.25 P. Bice, 17 Wyman St., Worcester, Mass.

Credit to Dr. Robert L. Carrel for his "Analysis and Design of the Log-Periodic Dipole Antenna" was in- advertently omitted in the article "Design of Log-Periodic Antennas" by VE3AHU in the May issue of 73. Our apologies to Dr. Carrel.

A few errors in the article "2m Beer Can Cavities" by WA2INM in the May issue: First, the article's title is a bit off base and part of the text is irrevelant. The cir- cuits described are coaxial circuits, not cavities. Also, point X referred to in the text is the link on coil L3. Point Y is the antenna input. Place the trimmer referred to in series with the antenna.

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June 1965

J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	7	7	14	14	14	14	14
ARGENTINA	14	14	14	7	7	7#	14	14	14	14	21	21
AUSTRALIA	14	14	14#	7#	7	7	7	7	7	7#	14#	14
CANAL ZONE	14	14	14	7*	7	7	14	14	14	14	14	21
ENGLAND	14	7	7	7	7	14	14	14	14	14	14	14
HAWAII	14	14	14	7*	7	7	7	7#	14	14	14	14
INDIA	14	14#	7#	7#	7#	14	14	14	14	14	14	14
JAPAN	14	14	7#	7#	7	7	7	14	14	14#	14#	14
MEXICO	14	14	14	7	7	7	14	14	14	14	14	14
PHILIPPINES	14	14#	7#	7#	7	7	14	14	14	14	14#	14
PUERTO RICO	14	14	7	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	7	7	7#	7#	7#	14	14	14	14	14	14#	7#
U. S. S. R.	14#	7	7	7	7	14	14	14	14	14	14	14
WEST COAST	14	14	14	7	7	7	7	14	14	14	14	14

CENTRAL UNITED STATES TO:

ALASKA	14	14	14	7*	7	7	7	14	14	14	14	14
ARGENTINA	14	14	14	7	7	7#	14	14	14	14*	14	14
AUSTRALIA	14	14	14	14#	7	7	7	7	7	7#	14#	14
CANAL ZONE	14*	14	14	14	7	7	14	14	14	14	14	21
ENGLAND	14	7	7	7	7	7*	14	14	14	14	14	14
HAWAII	14	14	14	14	7	7	7	7#	14	14	14	14
INDIA	14	14#	7#	7#	7#	7#	7#	14	14	14	14	14
JAPAN	14	14	14#	7#	7	7	7	14	14	14#	14#	14
MEXICO	14	14	7*	7	7	7	7	7	7*	14	14	14
PHILIPPINES	14	14	14#	7#	7	7	7	14	14	14	14#	14
PUERTO RICO	14	14	7*	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	7	7	7#	7#	7#	14	14	14	14	14	14#	7#
U. S. S. R.	14#	7#	7	7	7	7#	14	14	14	14	14	14

WESTERN UNITED STATES TO:

ALASKA	14	14	14	14	7	7	7	7	7*	14	14	14
ARGENTINA	14	14	14	7	7	7	7#	14	14	14	21	21
AUSTRALIA	14*	14*	14*	14	14	7	7	7	7	7#	14	14*
CANAL ZONE	21	14	14	14	7*	7	7*	14	14	14	14	14*
ENGLAND	14#	7#	7	7	7	7	7	14	14	14	14	14
HAWAII	14	14*	21	14	14	14	7	7	14	14	14	14
INDIA	14	14	14	14#	7#	7#	7#	14	14	14	14	14
JAPAN	14	14	14	14	14	7	7	7	14	14#	14#	14
MEXICO	14	14	14	7	7	7	7	7	7*	14	14	14
PHILIPPINES	14	14	14	14#	7	7	7	7	14	14	14#	14
PUERTO RICO	14	14	14	14	7*	7	7*	14	14	14	14	14
SOUTH AFRICA	7	7#	7#	7#	7#	7#	7#	14	14	14	14#	7
U. S. S. R.	14#	7#	7	7	7	7	7#	14#	14	14	14	14
EAST COAST	14	14	14	7	7	7	7	14	14	14	14	14

Very difficult circuit this hour.
* Next higher frequency may be useful this hour.

Good: 2, 14-19, 21-25, 27-29

Fair: 2, 4, 5, 7-9, 12, 13, 20, 30

Poor: 3, 6, 10, 11, 26

VHF DX: 5, 6, 13-16, 24

73

JULY 1965

40c Wow!

SPECIAL ISSUE

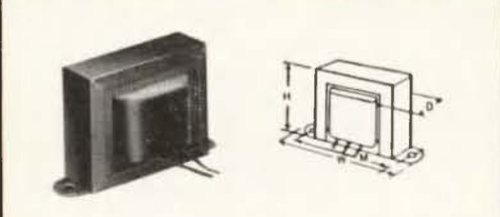
VHF

REPLACEMENT TYPE TRANSFORMERS & REACTORS

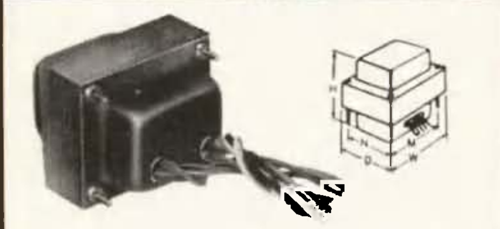
PIONEERS IN MINIATURIZATION

Thirty years of pioneering by UTC's research, design, and engineering staffs assures you quality and reliability unexcelled in the industry. UTC's line of stock and special custom built items covers virtually every transformer and filter requirement for both military and commercial use.

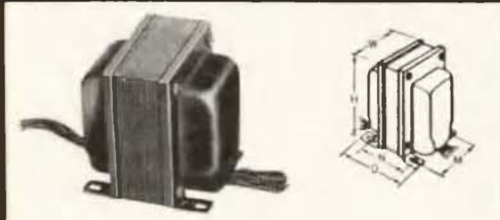
UTC replacement type transformers, here described, (Pri. 117 V. 50/60 cycles) provide the highest reliability in this field. All units are low temperature rise, vacuum sealed against humidity with special impregnating materials to prevent corrosion and electrolysis. Shells are finished in attractive high lustre black enamel.



CHANNEL TYPE



DOUBLE SHELL TYPE



VERTICAL SHELL TYPE

CHANNEL FRAME FILAMENT/TRANSISTOR TRANSFS.

Pri. 115 V 50/60 Cycles—Test Volts RMS: 1500

Type No.	Secondary	W	D	H	M	Lbs.
FT-1	2.5 VCT-3A	2 7/8	1 1/2	1 11/16	2 7/8	3/4
FT-2	6.3 VCT-1.2A	2 7/8	1 1/2	1 11/16	2 3/8	3/4
FT-3	2.5 VCT-6A	3 5/16	1 7/8	2	2 13/16	1
FT-4	6.3 VCT-3A	3 5/16	1 7/8	2	2 13/16	1
FT-5	2.5 VCT-10A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/2
FT-6	5 VCT-3A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/2
FT-7	7.5 VCT-3A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/2
FT-8	6.3 VCT-8A	4	2 1/2	2 5/8	3 9/16	2 1/2
FT-10	24 VCT-2A or 12V-4A	4	2 5/8	2 5/8	3 9/16	2 1/8
FT-11	24 VCT-1A or 12V-2A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/2
FT-12	36 VCT-1.3A or 18V-2.6A	4	2 5/8	2 5/8	3 9/16	2 1/2

Taps on pri. of FT-13 & FT-14 to modify sec. nominal V, −6% +6%, +12%

FT-13	26 VCT-.04A	2 1/8	1 3/8	1 1/4	1 3/4	1/4
FT-14	26 VCT-.25A	2 7/8	1 5/8	1 11/16	2 3/8	3/4

DOUBLE SHELL POWER TRANSFORMERS

Type No.	High V.	DC ma	5V. Fil.	6.3 VCT Fil.	W	D	H	M	N	Wt. Lbs.
R-101	275-0-275	50	2A	2.7A	3	2 1/2	3	2 1/2	2	2 1/2
R-102	350-0-350	70	3A	3A	3	2 1/2	3 5/8	2 1/2	2	3 1/2
R-103	350-0-350	90	3A	3.5A	3 3/8	2 7/8	3 13/16	2 13/16	2 1/4	4 1/2
R-104	350-0-350	120	3A	5A	3 3/4	3 1/8	3 7/8	3 3/8	2 1/2	5 1/2
R-105	385-0-385	160	3A	5A	3 3/4	3 1/2	4 5/16	3 1/8	2 1/2	7

VERTICAL SHELL POWER TRANSFORMERS

Type No.	High V.	DC ma	5V. Fil.	6.3 VCT Fil.	W	D	H	M	N	Wt. Lbs.
R-110	300-0-300	50	2A	2.7A	2 5/8	2 13/16	3 1/4	2	1 3/4	2 1/2
R-111	350-0-350	70	3A	3A	2 5/8	3 7/16	3 1/4	2	2 3/8	3 1/2
R-112	350-0-350	120	3A	5A	3 5/16	3 11/16	4	2 1/2	2 5/16	5 1/2
R-113	400-0-400	200	3A	6A	3 7/8	4 5/16	4 5/8	3	3 1/8	8

CHANNEL FRAME FILTER REACTORS

Inductance Shown is at Rated DC ma—Test Volts RMS: 1500

Type No.	Induct. Hys.	Current	Resistance Ohms	Dimensions, in. W	D	H	M	Wt. Lbs.
R-55	6	10ma	300	2 3/8	1 3/8	1 3/8	2	1/2
R-14	8	40ma	250	2 7/8	1 1/2	1 11/16	2 3/8	3/4
R-15	12	30ma	450	2 7/8	1 1/2	1 11/16	2 3/8	3/4
R-16	15	30ma	630	2 7/8	1 1/2	1 11/16	2 3/8	3/8
R-17	20	40ma	850	3 5/16	1 5/8	2	2 13/16	1
R-18	8	80ma	250	3 5/16	1 5/8	2	2 13/16	1
R-19	14	100ma	450	3 3/4	1 7/8	2 5/16	3 1/8	1 1/2
R-20	5	200ma	90	4 1/8	2 1/4	2 5/8	3 9/16	2 1/2
R-21	15/3	200ma	90	4 1/8	2 1/4	2 5/8	3 9/16	2 1/2
R-220	100/8 Mhy 25/2 Mhy	2.5A 5A	.6 .16	3 3/4	2	2 5/16	3 1/8	1 1/2

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73

Λagazine

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de W2NSD/1

never say die

The Docket

The deadline for your comments on this one is July 15th, so don't put it off any longer. Original (signed) and 14 copies (carbons OK) to FCC, Washington 25, D. C.

My views, expressed rather at length last month, are still the same . . . perhaps more so. I've talked this over in the interim with several hundred hams and a lot of old timers and no one yet has come up with any reasons why this FCC proposal will benefit ham radio. Sure, it will change everything and change it radically and this may be enough for those in our ranks who feel that "something must be done, no matter what." I still feel that we cannot hope to solve our problems until they are isolated and defined.

It is hard for me to dismiss from my mind the ridiculous start of this whole mess. Briefly, for those of you who have not been following the saga in 73 or K6BX's newsletter, here is the story:

1962 was a depressing year for the League. The Brass got together in December over a beer to glum over this and figure out what to do to make everyone aware of the glory of ARRL. Let's do something controversial. What? How about Incentive Licensing? OK, let's go. Since January was in the mail they whammed out a fine controversial editorial for February. The directors met in May and figured that the Brass must know what they are doing, go ahead. In October they followed through with RM-499.

The FCC now had the problem along with a request from the ARRL for "leadership and guidance." Well, we needed it along about then, but I'm afraid that the League turned to the wrong place, as many other groups have discovered in the past when they turned to the government to provide guidance and leadership. The FCC, hot potato in hand looked for someone to work things out and I understand, finally turned the whole works over to a non-ham lawyer and we ended up with 15928, lucky us.

I am hoping that you will join me in an effort to stop this ARRL inspired government creation from throwing ham radio into further unnecessary turmoil.

Big DXer

Now that I've become a DX hunter I've taken to reading the DX newsletters. I still agree with my original thought that there really is no way to provide any valuable DX news service in the pages of a monthly magazine. By the time something is reported it is usually all over but the shouting.

One thing that puzzles me though . . . Hammarlund has been sponsoring the DXpedition of the Month for over two years now and for some reason they just don't seem to try to get any publicity out of it. According to the latest list at hand they have the logs for 43 stations so far . . . a lot more than one a month. I notice it too when I go to send out QSL cards for contacts with some of the more interesting DX stations that I have contacted . . . the cards go to Hammarlund and get answered quickly.

Good show Hammarlund, but why keep your light under a bushel?

County Hunters

Though I personally think this business of trying to work gobs of counties is a bunch of horsefeathers . . . WAS is bad enough and look what DXCC has done to our DX bands . . . still, for those with little of importance to do in this world, hunting counties can be a big deal. I get a little perturbed when some

fellow comes along on the band and wanı to work me because I am in Greene Count} New Hampshire. I know right away exactl how much interest he has in me as a perso . . . zero.

Unfortunately for the county hunter crow they have had to send their QSL's into thε giant QSL trap down at CQ. One of the coɪ plaints that I heard quite often in Europe wa the futility of trying to ever get QSL's returne from there. Clif Evans K6BX has an answε . . . a new award . . . one where you will gε your QSL's returned, the United States Count Hunters Award. Information is available froɪ Clif (Box 385, Bonita, California) for 26c o 3 IRC's.

High Power

In an unprecedented (almost) move th FCC recently announced that it had suspende the license of Dale Hoppe W6VSS for runnin a little over the legal limit. As I understan the circumstances, Dale was sitting there chat ting away with someone when in walked th FCC inspector. Hmmm, ten kilowatts! Well it *does* put out a good signal. One of th chaps down here near Boston ran into prob lems with his 10 KW rig . . . he had so muc rf pickup from his mobile whip that it melte the final coil of his transceiver . . . and th gutters on the house lit up with corona ever time he talked . . . very spectacular.

Though the FCC has shown little interest in pursuing power violators, I do think wε should keep in mind that, even though it is illegal, it is also unethical to run all that soup.

Many amateurs ask why we don't lower the power limits to around 200 watts. Read the W4LCY article in the May 1964 issue of 73 and you'll see why. Every time the QRM goes down on a ham band enough to make it usable for commercial services they dig right in, ITU or no ITU agreements. In areas where ham activity is low our bands are jammed with non-amateur signals. So, if we lower our power all we are doing is cutting our own throats. In this day of relatively inexpensive kilowatts we would do well to keep our QRM level as high as we can . . . we'll hold our bands a lot longer. I suspect that this reasoning may be behind the lack of FCC prosecution of amateurs for overpower . . . until it has gotten completely out of hand.

Europe Again

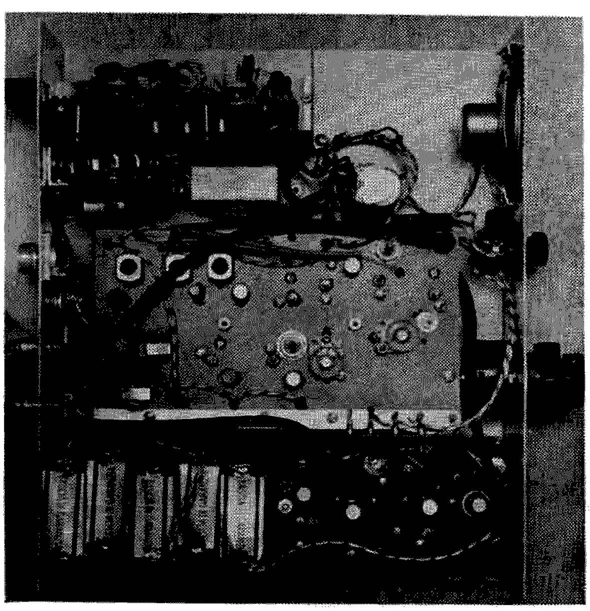
The purchase of a new Volkswagen 1500 squareback sedan in Germany just paid for a round trip to Europe. I like that sort of ar-

Cont. on p. 86.

Gianfranco Lovisolo I1SI
Viale Caldara 24,
Milano, Italy

2 Meter Transistor Transceiver

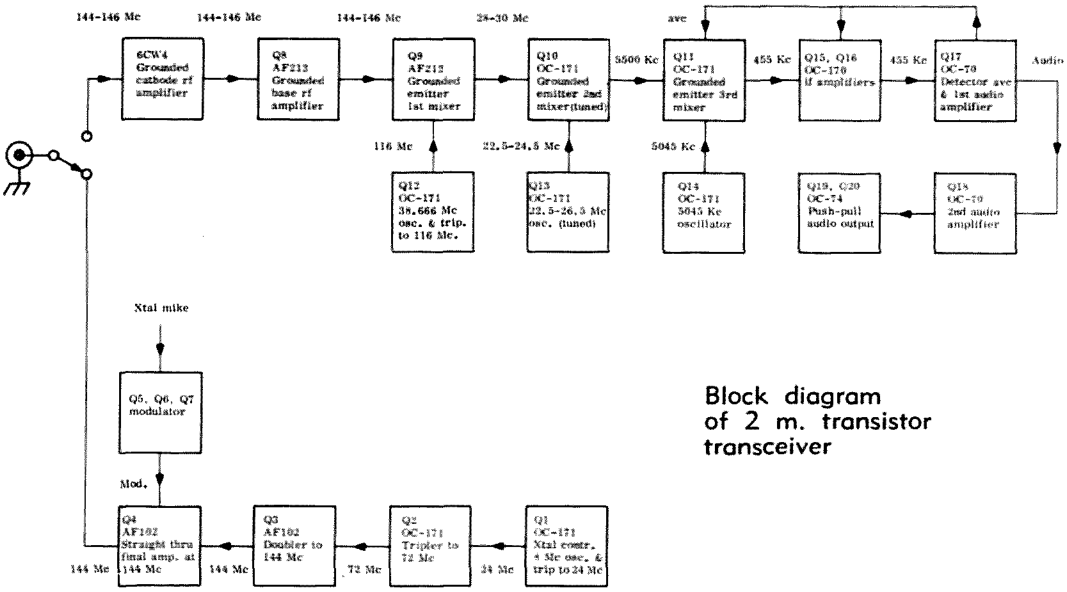
This transistorized transceiver was planned and built for portable and lightweight operation in the field. Receiver sensitivity and noise figure are excellent due to the use of a Nuvistor rf amplifier and triple conversion receiver. Transmitter final delivers a measured output of 30 milliwatts to the antenna. This power is of course in the QRP class, but, from favorable locations, it can give gratifying results. As a test, this transceiver was brought to the top of 4000 feet "Campo dei Fiori" mountain along with a Gonset "Communicator 4." The two sets were operated with the same ¼ wave whip antenna: the Nuvistor/transistor receiver compared favorably with the Communicator's, the only trouble being a tendency to overload on strong signals. On the other hand, the transistor receiver does not produce the annoying hiss common with the Commun cator 4. As for the transmitters, every statio which could be worked with the Commun cator, could be worked with the transisto transmitter. The signal strength reports wer of course favourable to the Communicator, bu if the Gonset set was given Q5, in most case Q5 was given to the transistor transceiver a well.



Top view of complete 2 m. transistor transceiver

Referring to the block diagram, the trans mitter starts with an 8 Mc xtal controlled os cillator and tripler to 24 Mc; 24 Mc rocks ca also be used with no modification to the cir cuit. This signal is fed to the base of Q2 whicl triples to 72 Mc; Q3 doubles to 144 Mc; Q is the final rf amplifier: collector voltage is 1 volts with no modulation and collector cur rent is 3.5 ma at full load and with a very noticeable dip. Input is around 50 milliwatt with an output (measured) of 30 milliwatts efficiency is little less than 60%. The modulator is a conventional resistance-coupled audio amplifier. Modulation is applied to the final only via modulation choke Z1 which is the only critical part in the modulator circuit. Modulation is clear and undistorted with this arrangement which proved to be superior to transformer modulation. Looking at the transmitter diagram, it can be seen that Z1 is fed from the 22.5 tap on the power pack: this is done to have at least 15 volts on the collector of Q4, since there is considerable voltage drop.

The receiver is made of two subassemblies: a xtal controlled converter with an *if* output between 28 and 30 Mc and a tuneable *if* receiver. The converter starts with a 6CW4 as rf amplifier which works with 22.5 volts on the plate and 9 volts on the filaments. This much filament voltage could be eliminated using a separate 6 volts battery and this I advise to do, although I have been operating it for



Block diagram of 2 m. transistor transceiver

ıny hours with no apparent damage to the be. The big disadvantage of this arrange- ent is the short life of B1 and B2 which must changed after about three hours of continu- ıs operation. By luck, these batteries are ıeap and can be easily replaced. Signal from 1 is fed to Q8 which acts as grounded base nplifier. Q9 is the mixer operated common nitter with harmonic signal coming from 12.

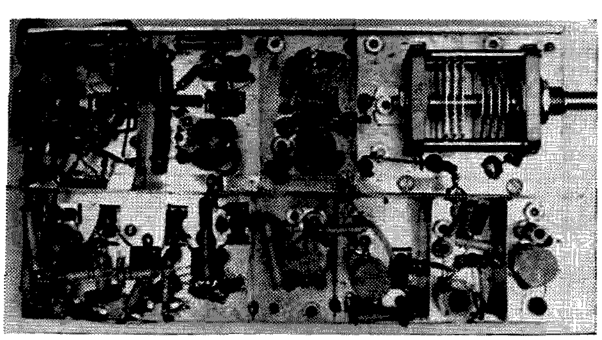
The tuneable *if* is made of two cascaded ixers Q10 and Q11 with separate oscillators, 455 kc *if* amplifier made of Q15 and Q16, Detector, avc and first audio made of Q17 ıd conventional audio stages following.

The converter and receiver were aligned to ›ver the two mc segment from 144 to 146 ıc which is the two meter European band. owever, the converter can be made to work om 144 to 148 mc with an output from 8 to 32 mc and the tuneable *if* can cover ıis 4 mc segment by the simple setting of ıe two trimmers C12 and C16 in series with ıain tuning capacitor C15. More on this ıter.

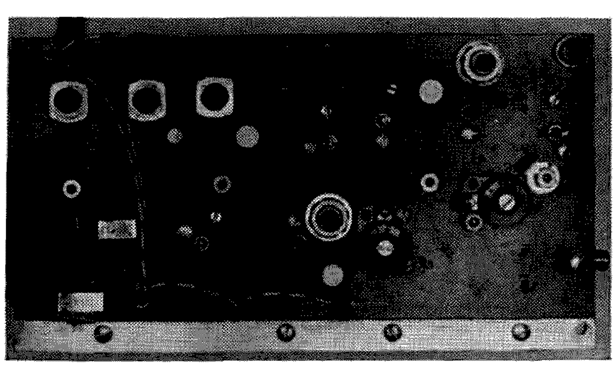
Construction and Alignment

The transmitter is shown in Fig. 2 with the modulator. It is built on a 4¾" x 2⅜" copper coated phenolic plate. It is suggested to follow the layout shown since it allows short connections and ease of wiring (see template A). The best procedure to save time and trouble is the following: drill all holes, mount all parts and then wire according to the diagram. Now check the resonate frequency of all coils with a grid-dip meter. With parallel condensers set at mid capacity and with transistors not inserted they should resonate a little higher than their proper frequency. Now put an 8 or 24 mc xtal in the holder and Q1 in its socket. Connect power to this stage through a 0-10 ma meter. Using the dipper as an absorption wavemeter couple it to LI, look for output and tune CI for maximum without losing sight of collector current.

Oscillation is marked by a dip on the milliammeter. When you have tuned up the stage let it operate for at least ten minutes watching

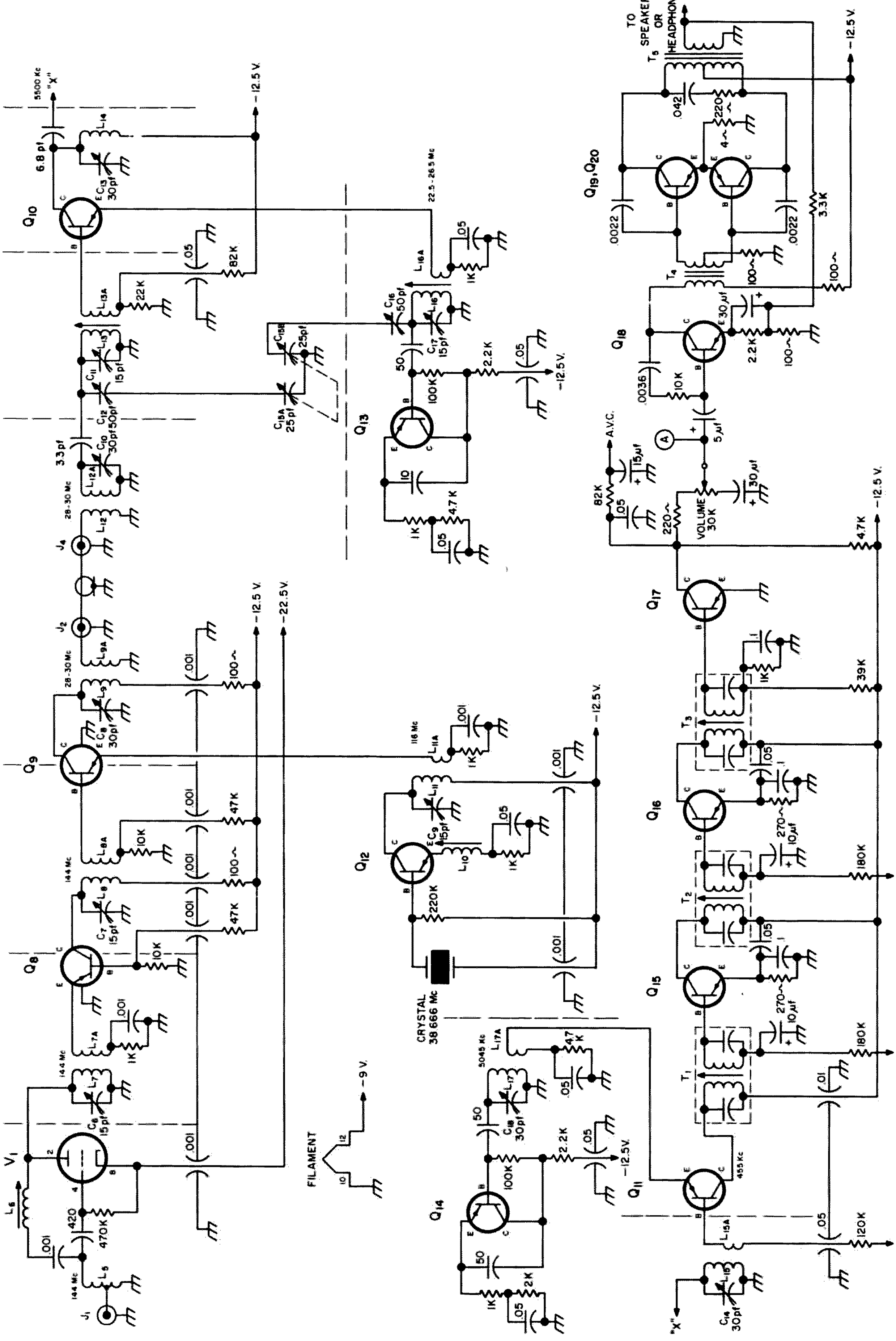


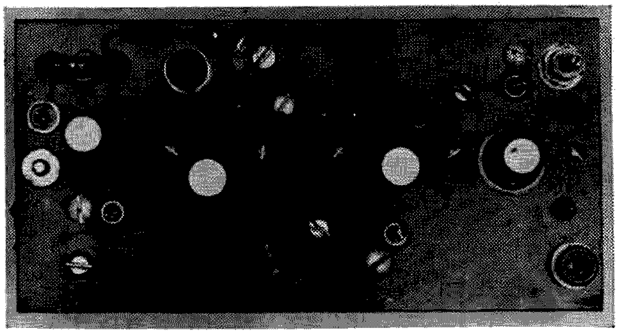
Bottom view of *if*

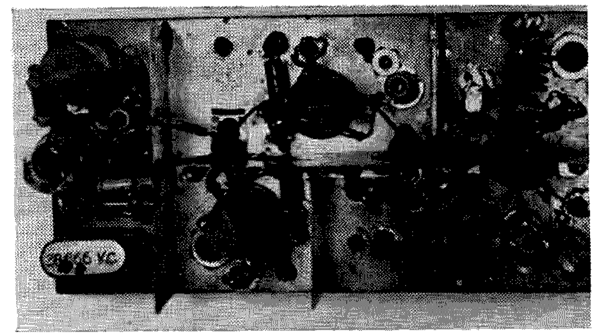


Top view of *if*

Fig. 1. 2m. receiver. Connect 2.2k resistor from —12.5v to CT of T_4.







Left: Top of converter. Above: Bottom view of converter

Receiver Coil Table

L5—144 Mc input coil; 6 turns #18 wire-air wound. Tap 2nd turn from ground—1/4" diameter
L6—6CW4 neutralization coil; 24 turns #28 wire wound on 1/4" diameter form-brass slug
L7—144 Mc nuvistor plate coil; 2 turns #24 wire (*) see note
L7A—Q8 emiter link (144 Mc); 2 turns #24 wire wound on cold end of L7 (*)
L8—Q8 collector coil (144 Mc); 3 turns #24 wire (*)
L8A—Q9 base link (144 Mc); 1 1/2 turns #24 wire wound on cold end of L8
L9—Q9 collector coil (28 Mc); 13 turns #29 wire (*) close wound
L9A—Output link (28 Mc); 2 turns #29 wire wound on cold end of L9
L10—Q12 emitter coils (28-30 Mc); 23 turns #29 wire close wound on 3/16" diameter slug tuned coil form (**)
L11—Q12 collector coils (116 Mc); 4 turns #24 wire (*)
L11A—Q9 emitter link; 1 turn #24 wire wound on cold end of L11
L12—28 Mc input link; 5 turns #29 wire close wound (*) on ground end of L12A
L12A—28 Mc input coil; 12 turns #29 wire close wound (*)
L13—28 Mc tuned circuit; 13 turns #29 wire wound on 3/16 diameter slug tuned coil form
L13A—Q10 base link; 2 turns #29 wire wound on cold end of L13
L14—Q10 collector coil (5500 kc); 32 turns #29 wire close wound (*)
L15—5500 kc tuned circuit; 49 turns #31 wire close wound (*)
L15A—Q11 base link; 8 turns #31 wire wound on cold end of L15
L16—Q13 collector coil (22.5 Mc); 8 turns #29 wire wound on 3/16" diameter slug tuned coil form
L16A—Q10 emitter link; 2 turns #29 wire wound on cold end of L16
L17—Q14 collector coil (5045 kc); 49 turns #31 wire close wound (*)
L17A—Q11 emitter link; 4 turns #31 wire wound on cold end of L17

Notes:
(*) All coils so marked are wound on 15/32" diameter plexiglass rods. See detail D.
(**) For proper operation of oscillator L10 must be resonant between 20 and 30 Mc. Exact frequency is not critical.

T1—455 kc *if* transformer
T2—455 kc *if* transformer
T3—455 kc *if* transformer
T4—audio interstage transformer
T5—audio output transformer

the collector current to see if there is a tendency toward thermal runaway. If this ha pens increase R2 in small steps. Now p Q2 in its socket, apply power to this sta always through the milliammeter and tune (for maximum reading of the grid-dip met In the same way tune up the following stag Do not be afraid to lose drive to the mı tiplier stages; if this happens the transistc cannot be damaged since they are at cut- with no drive. When you are confide every stage is working properly, you c check the modulation by listening to it your 2 meter receiver.

Receiver

The tuneable *if* receiver is by far the mc critical part of the entire rig. It is built on 9" × 3¾" copper clad phenolic plate. S template B. Form the complete intersta shield by following dimensions given in te plate B: all parts for this shield are cut o of 1½" high thin brass strip and then s dered together.

To facilitate wiring of the *if*, the shield soldered in place after wiring is completed. advise following the layout shown carefu since it prevents all troubles due to unwant coupling between stages.

When wiring is completed and the shie is in place, start checking the audio stage connect a loudspeaker across secondary of and an audio signal generator (or any oth audio source such as the output from a reco player) to point A: audio output should clean and undistorted. Next tune the 455 *if* (Q 17, Q 16, Q 15), by connecting a mo ulated signal generator across primaries of T T2 and T1 and tuning these transformers f maximum output as seen on a ac voltmet connected across the loudspeaker. If how and whistles are heard when all the 455 transformers are tuned the *if* strip must neutralized. This is accomplished by reversi the secondary leads of T2. This should gi a marked inprovement: if however oscillati

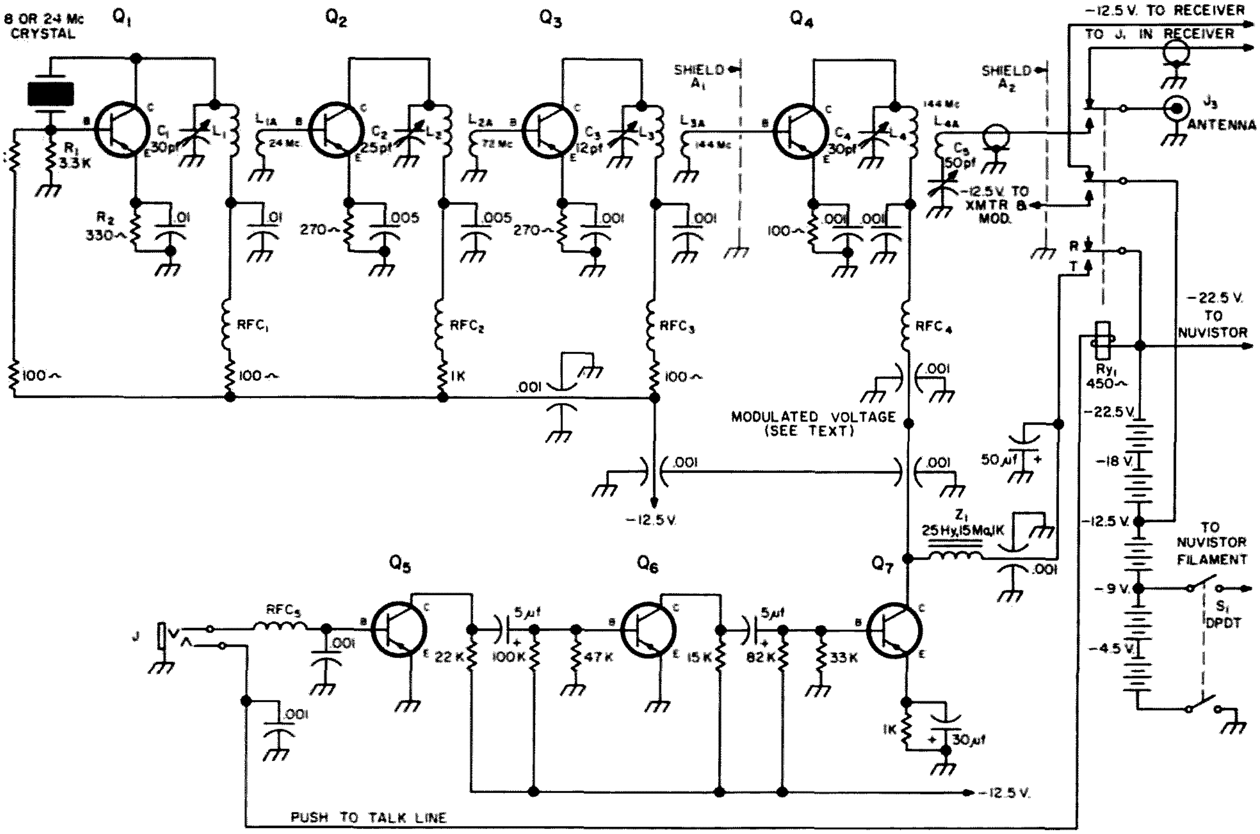


Fig. 2. 2m transmitter

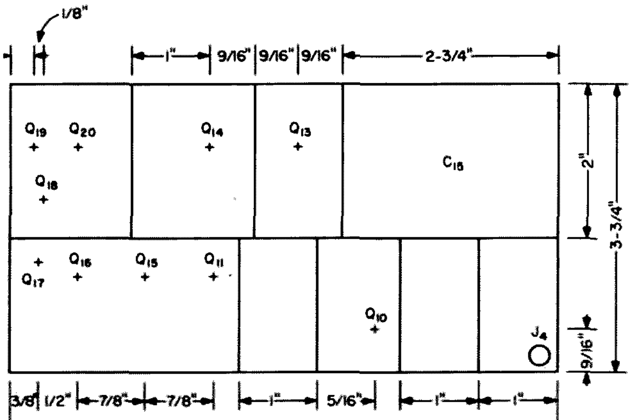
Transmitter Coil Table

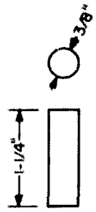
: 18 turns of #32 wire on 1/4″ coil form: close wound
A: 4 turns of #32 wire wound on cold end of L1
: 7 turns of #28 wire on 1/4″ coil form: close wound
A: 3 turns of #28 wire wound on cold end of L2
: 3 1/4 turns of #18 wire air wound: coil diameter 1/2″, coil length 5/8″
A: 2 turns link of #18 wire (insulated)[1] inserted between turns of L3
: 3 1/4 turns of #18 wire air wound: same dimensions as L3
A: 1 3/4 turns of #18 wire (insulated)[1]: inserted between turns of L4
ote: Insulation is made with spaghetti to prevent accidental shorts with collector coils.

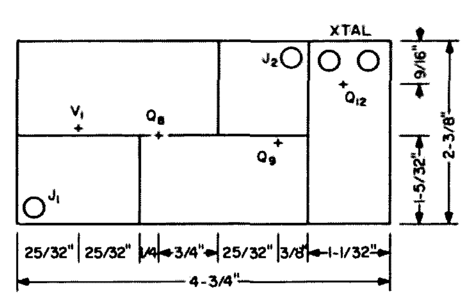
Transistors

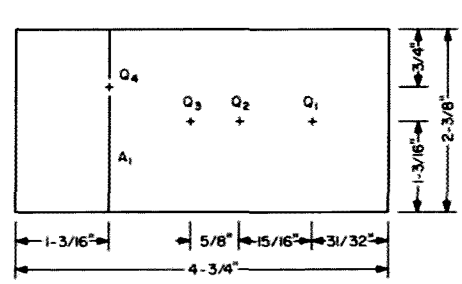
Q1, Q2: OC171, 2N1517, 2N2084
Q3, Q4: AF102, 2N2084, 2N2671
Q5: OC71, 2N2428, 2N1274
Q6, Q7: OC74, 2N109, etc.
Q8, Q9: AFZ12, 2N2495, 2N2360, 2N2084
Q10-Q14: OC171, 2N1517, 2N2084
Q15, Q16: OC170, 2N156, 2N267
Q17, Q18: OC70, 2N2428, etc.
Q19, Q20: OC74, 2N109, etc.

American types are editor's suggestions. Many other types will also work.









bove: Detail B, receiver *if* layout. Top right: C, converter. Bottom right: A, transitter. Center: Detail D, coil forms.

does not stop, connect a small condenser (from 3 to 12 pf) from the base of Q16 to the collector of Q15.

When the 455 *if* is operating properly, check rf output from Q14 by coupling the GDO tuned to 5045 kc to L17 and tuning C18 for maximum output at this frequency. Now connect the signal generator to the base of Q11 and tune it back and forth around 5500 kc: output from the generator should be heard in the loudspeaker. After this, set the generator to exactly 5500 kc and tune C18 and C14 for maximum output.

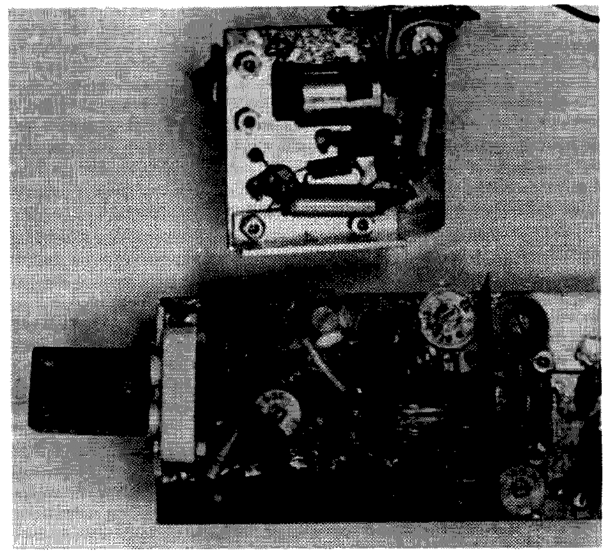
Next, check for output from Q13 with GDO coupled to L16. With C15 at maximum capacity, slugs on L16 and L15 at half range, tune C17 to read approximately 22,500 kc on the GDO. If you cannot reach this frequency, tune C16 toward more capacity. Tune slug of L16 and capacitors C16 and 17 to have an oscillator range of at least 4 Mc from 22,550 kc (C15 all meshed) to 26,500 kc (C15 all open).

Connect the signal generator to J4: set it at 28 Mc and turn C15 to maximum capacity: now adjust C12 for maximum output. Set generator to 30 Mc, tune C15 to receive this signal and adjust C10 for maximum output. Next set generator to 32 Mc, tune C15 to receive this signal and adjust C11 and L13 for maximum output. Repeat the above procedure several times, since these adjustments interact. When the 4 Mc coverage is accomplished and Q10 and Q13 are tracking properly, set again generator to 30 Mc and tune C13, C14 and C18 for maximum output. This alignment is easy if it is remembered that C12 and C16 are in series with the two sections of C15: to get more coverage from the main tuning condenser, C12 and C16 must be adjusted to increase their capacity.

Converter

The 144 to 28 Mc crystal controlled converter is built on a 4¾" × 2⅜" copper clad phenolic plate. See template C. Again form the interstage shield, wire all the assembly and then solder the shield in place. Prior to alignment, test all coils with the GDO and bring them to resonate on the proper frequencies by means of the parallel trimmers. This initial adjustment must be done with transistors off their sockets.

Alignment of harmonic generator Q12 is as follows: connect power to this stage through a 0-10 ma meter: slowly tune slug of L10 till you see a dip on the meter: Q12 is now oscillating. If oscillations do not start, L10 is either too high or too low on frequency: this



Top: Modulator. Bottom: Transmitter

coil must resonate between 20 and 30 M to reach the right frequency, remove tur from the coil till it resonates broadly approximately 32 Mc; now connect a 50 trimmer in parallel with the coil and tune for dip on the meter. The trimmer can nc be removed and fixed capacitor connected its place. With Q12 oscillating, couple t GDO, tuned to 116 Mc, to L11 and tu C9 and L10 for maximum output.

Connect a short cable between J2 and communications receiver tuning from 28 32 Mc (The variable *if* can be used if y have already aligned the dial). Set receiver 28 Mc, signal generator to 144 Mc and cc nected to J1: adjust C6 for maximum outpı generator to 146 Mc, receiver to 30 Mc: adjı C7 for maximum output; finally generator 148 Mc, receiver to 32 Mc and tune C8 maximum output.

V1 must be neutralized: to do this, discc nect −22.5 volts to this stage leaving filament power. Tune in on receiver a stro signal around the middle of the band w J1 connected to your 144 Mc antenna ham friend living nearby could supply such signal) and adjust L6 for ***minimum*** outp

Assembly

The pictures show how the subassembl were mounted on the main chassis: any otl layout could be chosen to meet individı requirements. The *if* main tuning capacitor turned by means of a 1:10 reduction dri Transmitter and modulator subassemblies mounted vertically, while converter and va able *if* are mounted on pillars cut out of t copper tubing. For frequency stability, least four pillars should be used for the va ble *if*.

. . . 11S

12 db @ 33¢/db

Bill Nogues W5GVE/4
2601 Choctaw
Dothan, Alabama

A Simple 2m Collinear

A while back, a ham got tired of fighting poor signal reports on two meters. So, he built a series of yagi antennas. Some improvement, but not worth the blood, sweat, tears and *time* wasted in trying to resonate the things, broaden or narrow major lobes, drop SWR, etc., etc., etc. It was all of the etc.'s that tired that ham (me). The etc.'s were mostly raising and lowering antennas by hand; very tiring work . . . but, I came to a conclusion:

The extra-ordinary ham, of course, has the knowledge, skill, instruments, and *time* to properly design, build and tune those tricky yagis; but how about the rest of us, the "average" hams? Is there no two meter antenna that is broad-banded, that is not so sharp directionally that being 10 degrees off one way or the other misses a signal, that needs

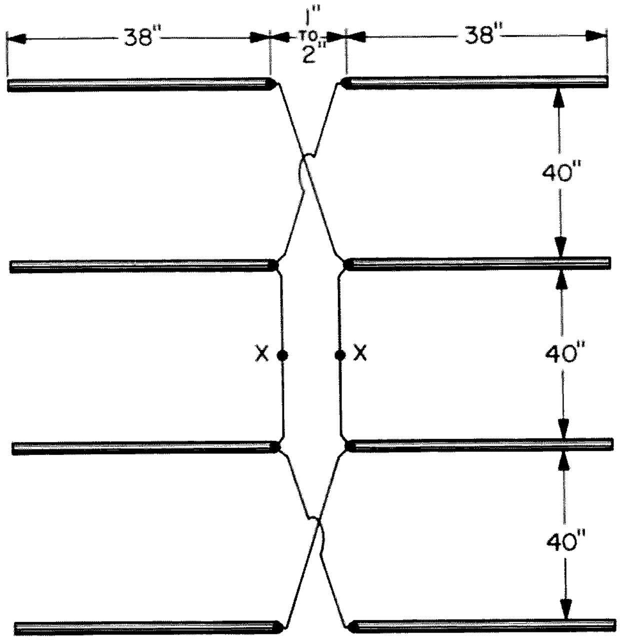


Fig. 1. Configuration of collinear.

little or no adjustment to get that SWR down! Yes, the collinear array.

This is the answer for the "average" two meter ham. This is the antenna that works like a charm the first time. The 16 element version described here is roughly the equivalent of eight 2-element beams, is easily fed and has a large "capture area" (this is good on two meters).

A collinear curtain consists of eight horizontal half-wave driven elements, arranged four high and two wide, and spaced 1 or 2" end to end, horizontally, and ½ wave apart vertically. See **Fig. 1.** Such an array radiates broadside, that is, into and out of the page. The feed point impedance of an end fed half-wave is quite high, but by feeding several it can be brought down to under 1000 ohms (a value that can be manipulated).

A set of 8 reflectors should back up our 8 driven elements to bring the impedence down further, and also to improve the directional qualities of the antenna. These reflectors should be 40" long (using ¼ to ½" tubing). Spacing them .2 wavelengths (16") behind the 38" long driven elements will bring the feed-point impedence (X-X) down very close to 300 ohms. So much for theory.

In practice, the heart of the collinear array is the physical supporting structure. You can build the thing all-metal, as in **Fig. 2.** Since the driven elements and reflectors are supported at voltage nulls, no insulation is needed. This kind of construction works find. But—look at the size and at the relative complexity of construction that this all-metal array presents to the average ham-type builder, who is armed only with hacksaw, hand tools, and hand drill.

There is another way to support a collinear, and it's the method used by most of the antenna manufacturers. A look at **Fig. 3** will

how you why. You can see that physically his is simpler; the only catch is that the nsulators must be both non-conductive at two neters and strong enough to support up to :0″ of element on either side of it. You can ee that electrically this type of construction ; much "cleaner," having less metal floating round to adversely affect pattern, SWR, tc. It decreases the XYL-R, too, due to its ieater (and lighter) appearance.

Well, having long been sold on collinears ver yagis, and, more recently, sold on insula-ive over all-metal construction, it appeared hat the only thing standing between me and *good* antenna was the little matter of those special" insulators. But, when you are as dumb s I am, you have to be lucky . . . and sure nough, I lucked in. I found myself in Sears Roebuck one day, and I wandered into the lumbing department by mistake (dumb but ucky, remember). I had this antenna dilem-na on my mind, so you can imagine my urprise and delight when I looked up and aw a whole pile of my "special" insulators for !9c a shot. Of course I corralled the nearest alesman and applied pressure at his elbow intil he agreed to break open a dusty catalog rder book to determine just what those little eauties were made of. After a little search, ie was able to supply me with flow-data, tc., *and* inform me that they were made of NYLON. They were nylon "T's" for plastic ipe used in do-it-yourself plumbing. I bought

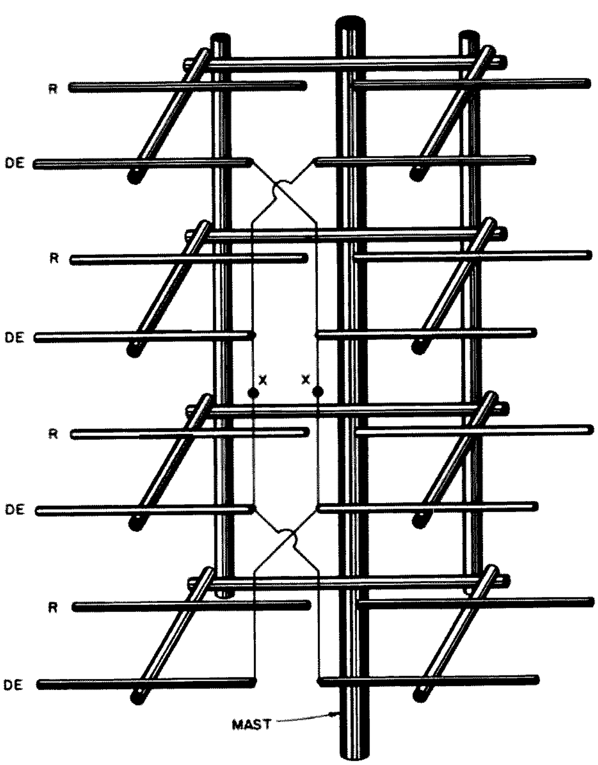


Fig. 2. All-metal construction.

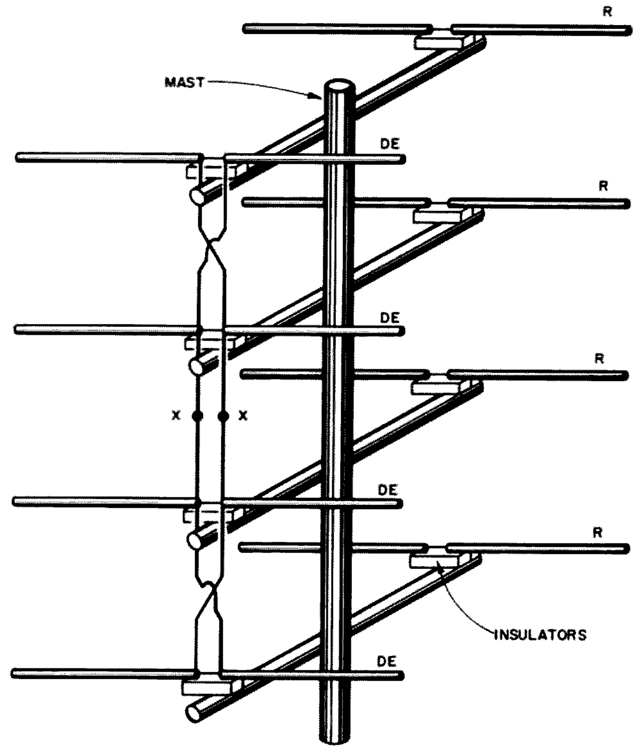


Fig. 3. Simplified construction.

8 and left the salesman wondering about my plumbing project and my sanity.

These "T's" come in at least two sizes. I got the smaller size—just a shade over $\frac{5}{8}$″ O.D. They are designed to be jammed into plastic pipe, so they have raised, sloping rings on the connecting portions that act like barbs to secure the joint. This also helps hold them when they are jammed into aluminum tubing that is $\frac{5}{8}$″ I.D.

The collinear elements are inserted into the "arms" of the "T" and secured there by means of 6 × $\frac{1}{2}$″ sheetmetal screws (**Fig. 4**). Drilling the small pilot holes for these screws was troublesome until I found that the smooth, curved Nylon surface could be "dimpled" by touching with a warm soldering gun. I also discovered drilling the pilot holes in both the element and the "T" for the "A" screws before assembly was the easiest method. After the "A" screws are in, one shot of the hand-drill will drill the hole for the "B" screws in the "T" and the element simultaneously. Naturally, it goes almost without saying: don't over-tighten these screws. Remember, this is soft nylon and soft aluminum.

Since the driven elements have to be fed at the end (and inside the "T"), it is necessary to put an electrical connection at screw "A." I found that thin strips of copper drilled to pass the "A" screws worked fine. If you want to solder these copper tabs to screw "A," do it before screw "A" is set in the nylon. Another word of caution: drilling small strips of

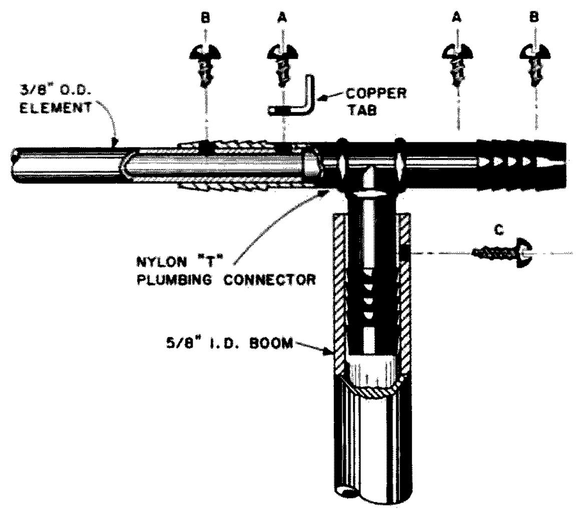


Fig. 4. Details of insulators.

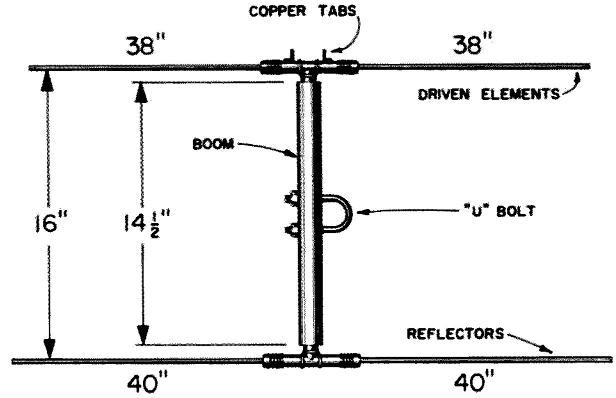


Fig. 5. Layout of single bay.

copper with a hand-drill can be painful. The copper is tough and will bind on the drill, spinning around chopping fingers. It is easier if the holes are drilled in a larger piece of sheet copper before you cut it into smaller strips. The larger piece of copper is easier to hold on to.

After 2 driven elements are secured in one "T" and 2 reflectors in another, plug the 2 "T's" into the ends of the ⅝" I.D. boom. Lay this H-shaped bay on a flat surface, such as a porch or driveway. This lines up the driven elements and reflectors into the same plane. Be sure that your U-bolt holes are also in this plane by running a long, straight rod through them. When all the elements and U-bolt holes are flattened out, drill the pilot holes for the "C" screws, and insert them. See **Fig. 5** for the layout of a single bay.

When you have built 4 of these bays, you are ready for a rest. All that remains now is to stack these 4 bays on a mast and hook up the phasing and feedlines. When you have the bays stacked on the mast, 40" apart, and all facing the same direction, solder the phasing lines to the copper tabs on the driven elements' "A" screws as shown in Figure 1. The ARRL Antenna Handbook says to use #18 copper (or copperweld) spaced 1"; so copper I used. Where the phasing lines cross, between the central and outer bays, a couple of home-made phasing line separators are in order. Any good insulator that will separate the phasing lines by about an inch will do the job. I happened to have on hand, and used, thin strips of plexiglas slotted at the ends. After the lines have been slipped into the slots, a touch of the soldering gun will fuse the slots closed tightly over the wire, keeping the separators in place on the line.

Attach your 300 ohm twinlead, open-wire line, or 4 to 1 coax balun at the points marked X-X on **Fig. 1**. Lift the thing into the air and use your creation. Store bought arrays are dandy, but they never quite give the same feeling of accomplishment that a well-constructed home-brew antenna does. Besides store bought arrays are worth every cent you pay for them, but they do cost in the neighborhood of $20. I managed to build mine for less than $3, but I had a head start . . . I had the U-bolts on hand. Assuming that any ham worthy of the name can make sure he falls heir to a graveyard of busted TV antennas, the array here can be built for about 33c per db, *i e*, $4 for a 12 db antenna. TV antennas, especially those terrible conicals, are generally built of the approximately ⅜" O.D. aluminum tubing used here. If you can't find any of the approximately ⅝" I.D. tubing in the booms of the TV antennas, you may have to surrender and purchase some conduit (aluminum). Mine was built largely with what I had on hand or could easily scrounge. If these methods or materials don't suit you, follow your nose, improvise; it's part of long-standing ham tradition.

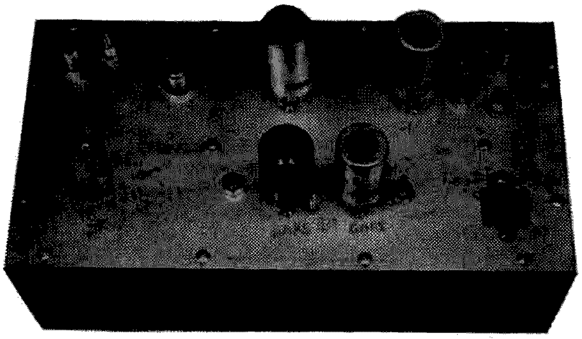
Parts List

8 lengths of ⅜" tubing 38" long (aluminum)
8 length of ⅜" tubing 40" long (aluminum)
4 lengths of ⅝" I.D. tubing, 14½" long, and drilled for
4 U-bolts (size depending on your mast)
About 40 #6 x ½" sheet metal screw (Sears calls them #7137-Binder head gimlet point zinc plated sheet metal screws, and sells them 20 to a box for about 20c)
8 nylon "T's"—⅝" plus O.D.
8 copper tabs 1" x ¼" drilled at one end to pass above screws
About 21" of #18 copper wire
2 or 4 plastic separators 1¼" x ¼" x ¼"

Construction time is less than 4 hours, even if you are as non-mechanical as I am. Just be sure to line up the materials beforehand.

The resultant 12 db forward gain antenna will increase your enjoyment of two meter since you will be able to "hear" as well as to be heard much further. Good luck, and be seeing you via Oscar IV.

. . . W5GVE



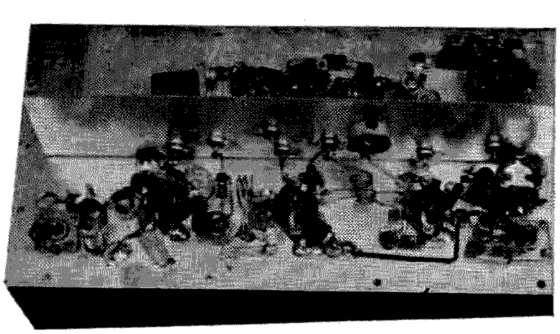
Henry H. Cross W1OOP
111 Birds Hill
Needham 92, Mass.

220 mc Converter No. 9

(Not a construction article)

I don't make them all alike, because ham radio is a hobby, and the fun in *making* them is to try something that is at least a little different from the conventional.

This converter started out as an argument. It was a test bed for several rf stages using the 6CW4, at the same time that I was fooling with a somewhat modified Tapetone 220 converter. The original idea was to get a comparison between the 417 and Nuvistor rf stages. The upshot was that I convinced myself (the detailed evidence should also work on other skeptics) that while a 417A of good antecedents and the right brand is slightly better in NF at 220 mc than the 6CW4's I tested, the improvement is bought at about $110 per decibel. (Not to say that you can't do better; just that I didn't.) The comparison was valid because the converters were the only differences between the two setups, and correction for the second stage contributions was made in each case. I tried the 6CW4's grounded-grid first; at 220 that grid lead is too long for stable operation. Neutralized, the noise figure was the same as I later found the grounded-cathode connection to be . . . a bit under 5 db. Neutralizing the g-g Nuvistor was trickier than for grounded cathode, hence, I do not recommend it. The 417, by comparison, is stable, and seems to need no neutralization, as the layout is of course ideal for grounded-grid. There is a new g-g Nuvistor that should be excellent if it can be obtained.

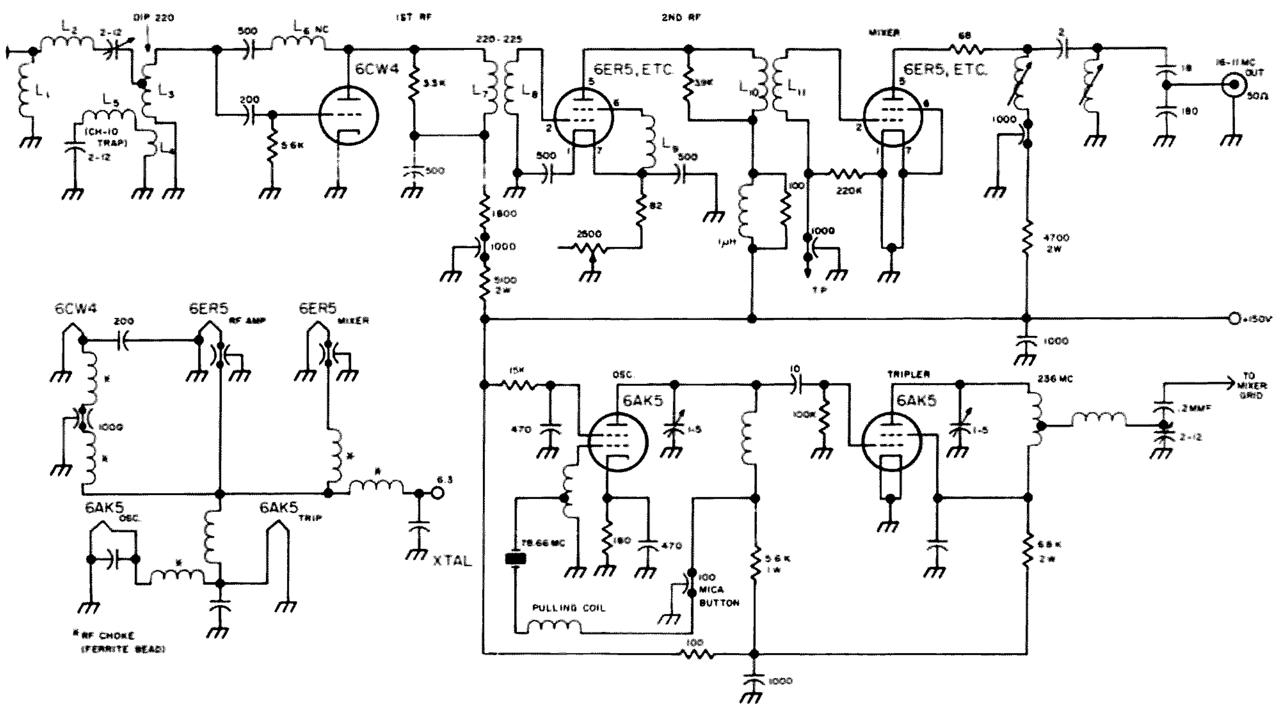


Bottom view. Input on left. Mixer to right. Crystal oscillator behind partition.

Aside from the first rf stage, which is conventional (other than the channel 10 trap which is built around the input network) there are a few novelties in the rest of the circuit:

1. The oscillator is on the high side so you'll get no images from TV. 236 mc means that you tune 16 to 15 for 220 to 221. The circuit is not original, but seems somewhat more stable than the more common Butler oscillator. The first 6AK5 acts as an overtone oscillator, with the crystal series resonance in the low-impedance feedback path. A coil or capacitor in series permits a small adjustment of the frequency to get calibration. The second 6AK5 is a tripler to 236 mc. A double-tuned network filters the drive which is coupled to the mixer grid by a capacity probe sticking through the partition.

2. The second rf stage uses a 6ER5 or 6FY5. These are somewhat overlooked by many hams; they are better and simpler than, for instance, a 6BQ7. For one-band use the neutralization is simple, similar to what's used in many pentodes on six meters. The shield is only that (no current flows) so the noise formulas for triodes apply. In this application, the excess gain is held down by a cathode bias pot. Probably the second stage is not needed, but calculations showed that it *might* make as much as a decibel difference in overall noise figure, so in it went. (I use a single 6FY5 on 144 ahead of a 6CB6 mixer, for instance).



220 mc converter. Unmarked capacitors are 500 pf.

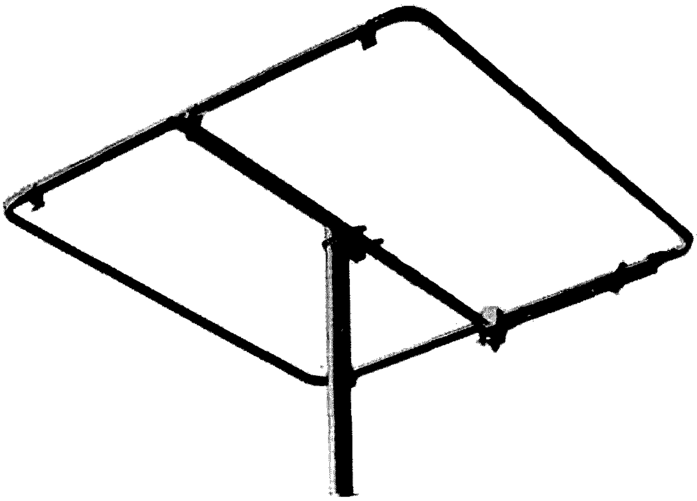
3. The mixer is a 6ER5. Very successful. The shielding is just what triode mixers always needed. Grid-leak bias makes for easy adjustment and provides a "detector" test point for sweeping the rf, or tuning up on a signal generator. There was sufficient injection available—2.5 volts at the test point was found best—to permit coupling quite loosely to the multiplier tank.

The *if* output circuit and general layout are similar to the Tapetone converters, as interchangeability made the aforementioned tests simpler. Apparently the oscillator-multiplier circuits are well shielded to avoid spurious beats, as there are two BC, three TV and four FM stations within a few miles of my QTH. (Channel 10, which gives me the most trouble on 220, is about 30 miles away).

To make such a collection of conditionally stable tubes perform properly, tuneup proceeds from output to input. The oscillator is made to run with 22 ohms where the crystal should be; when it's on the right frequency, substitute the crystal. The tripler primary is tuned for maximum soup as indicated on a grid dipper on the right frequency (in the diode position) and then the second 236 trimmer is adjusted to dip the primary rf. (Later trimming uses mixer grid bias, read at the test point.) The mixer grid coil is peaked to 222 with all power off, and the second rf plate coil loaded, detuned or shorted. Then the mixer has a detuning capacitor clipped across its grid coil and the second rf plate coil is initially tuned, also to 222. A signal is fed via coax to the second rf grid and the neut coil (between shield and cathode) is squeezed or stretched until the signal vanishes or at any rate is almost completely nulled out, the local oscillator and mixer being in action, but no heater power on the tube being neutralized. Once this is done, the 6ER5 grid and plate coils can be set to band center with the grid dipper, taking care to short the opposite windings of each pair. The Nuvistor grid plate neutralization coil is adjusted in a similar manner, but this coil will of course be much more sensitive to hand capacity. An orange-wood stick (get it from a manicurist or AT&T repairman) is handy for the coil adjustment.

RF stages. Input jack on left. 2-12 mmf oscillator trimmer at upper right.

The input adjustment will go fastest if you have an automatic noise-figure meter, but I use (at home) a target signal—a transistor oscillator or a long-winded ham—and a receiver with good avc action. It becomes easy to tune for best signal to noise ratio, which, of course, is what all this folderol was intended to accomplish. . . . W1OOP



Joseph Shapiro WA2ZCH
67-22 214 St.
Bayside, N. Y. 11364

The Cushcraft Squalo

Now that you've been reading Cushcraft's Squalo ads in 73 for the past several months you're probably wondering if the cute little things really work. Yep, they do. The Squalo series consists of models from 2 meters on down through 40. They're a full half wave on all bands and horizontally polarized. They are nice and cheap ($8.45 up) but sturdily put together and have a radiation pattern which is essentially omnidirectional. Now the big plus . . . facility of mounting. This antenna can be put in more positions than Little Egypt. No kidding, you can mount it on anything (witness cover of 73 Jan. 65). They all mount beautifully on a tower. In fact the Cushcraft people would have you festoon a tower (or even rather light mast) with several Squalos for different bands. Not a bad idea, especially for you city-suburbanites where the real estate ads called the plots "estate sized" but you found it must have been a scale model, you bought. The largest model, for 40 is a comparatively small 16 feet square, the 20 meter version is only 100 inches square and the ten meter job is a tiny 50". The same rod that supports the Squalo on a mast can be swung around to one end and you can easily flip the thing out a window (making sure you hold on to the other end). This is a great antenna for portable operation because you can easily separate it into its four sides so even the largest can be tied onto the side of the car and transplored. When you put the thing back together it's a cinch. In fact you'll be finished before you could even untangle a dipole.

Here's the best part of all. The six meter model comes with suction cups which definitely makes it the best mobile antenna going. The CB version also comes this way, but not the 10 meter job. If you work 10 mobile, buy the 11 meter job and trim it a bit. The suction cups enable the antenna to be popped on the center of the car roof, like a luggage rack. This has a great effect on radiation pattern. The bumper mount halo or whip is not omnidirectional like the book says but in fact has a rather sharp lobe across the front of the car. The Squalo, by virtue of its center roof mounting position is much more omnidirectional. This all adds up to a great reduction in QSB on both transmit and receive. Also, it seems to me that ignition noise (especially from other cars) is reduced somewhat.

Helpful hints: When assembling the thing don't guesstimate the correct dimensions (which can be varied a few inches) or you will probably find the SWR heading west. Use a bridge and start with Cushcraft's suggested dimensions. Then a little poking around here and there will easily bring the SWR down to excellent levels. If you have problems getting the suction cups to stay stuck where you want them, a little vaseline or glycerine judiciously applied under the suction cups will turn the trick. Also take it from me, don't play with the Reddi match. It's right when it comes from the factory. One of the best things about this antenna is that you don't have to fool with baluns or matching networks to get a good SWR so take advantage of it.

You can use a standard bumper mount and mast on the higher frequency squalos but why lose the really great reduction in QSB when the roof top mounting is used. Of course you may have to use a bumper mount if you own a convertible, unless you typically ride with three bald men who don't mind sitting very still . . .

. . . WA2ZCH

Walton Taylor WA6SIZ
3548 Sophia Way
Sacramento 19, Calif.

Push Pull 5763's on 144

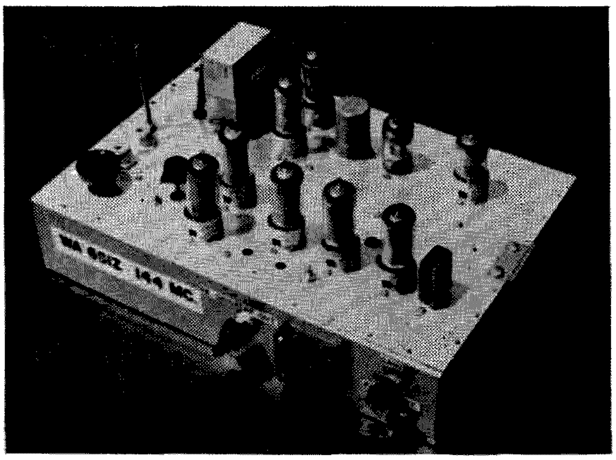


Photo Credit: WA6QDY

The club station for Aerojet-General Company's amateur employees owns Heath Sixers and Twoers which are circulated among members to give them a chance to try VHF bands. This got me on two meters—building and checking out a "Twoer" for W6IJK. Wanting something better than the "Twoer's" super-regen receiver, I built a nuvistor converter[1] to go with my NC-300, continuing to use the "Twoer" as the transmitter.

The Sacramento two meter gang kidded me unmercifully for having a ninety dollar receiving saddle on my twenty dollar transmitting mule. So I had to design and build a suitable transmitter complete with modulator to get out from under this barrage of kit-and-Gooneybird owner insults.

W6PIV suggested I consider using as a final, the 5763 which is often a driver but seldom a final. At two and a half dollars a copy, five dollars worth of 5763's is almost the rf equal of a six dollar 6360 (a dual tetrode very popular on two).

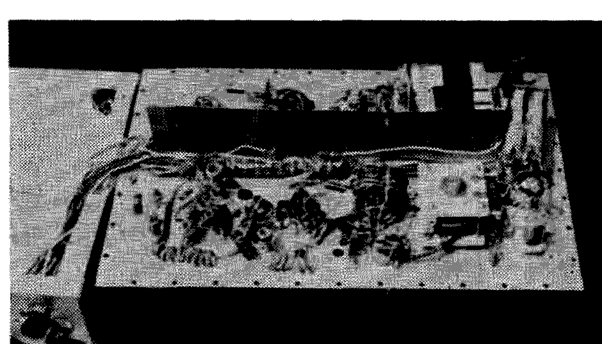
Tube manuals give the 5763 a maximum full rating frequency of 50 mc, and also give its characteristics as a multiplier up to 175 mc. With such capability as a multiplier at hard-to-reach VHF, I was led to the conclusion that the 5763 should perform well as a final amplifier on 144 mc.

I had a spare 10 watt modulation transformer with 1 to 1 primary to secondary windings, so another pair of identical tubes modulating the pair at rf seemed a logical choice, both as to power rating and impedance matching. No audio service ratings for the 5763 came to hand in my design research. I tried them and they worked.

The rf section of the transmitter is entirely 5763's, conventional in design and coupling. The first is a Colpitts "hot cathode" oscillator using 8 mc crystals with its plate tuned to 24 mc. The second is a tripler to 72 mc, the third a doubler (cathode keyed for CW) to 144 mc, with these stages using capacity coupling. I experimented with both link and capacity coupling of double tuned circuits (notice the unoccupied holes in the chassis just north of the 24 and 72 mc slug-tuned forms) but found capacitative coupling of single tuned circuits easier to set up and adjust, and almost as broad-banded for QSY.

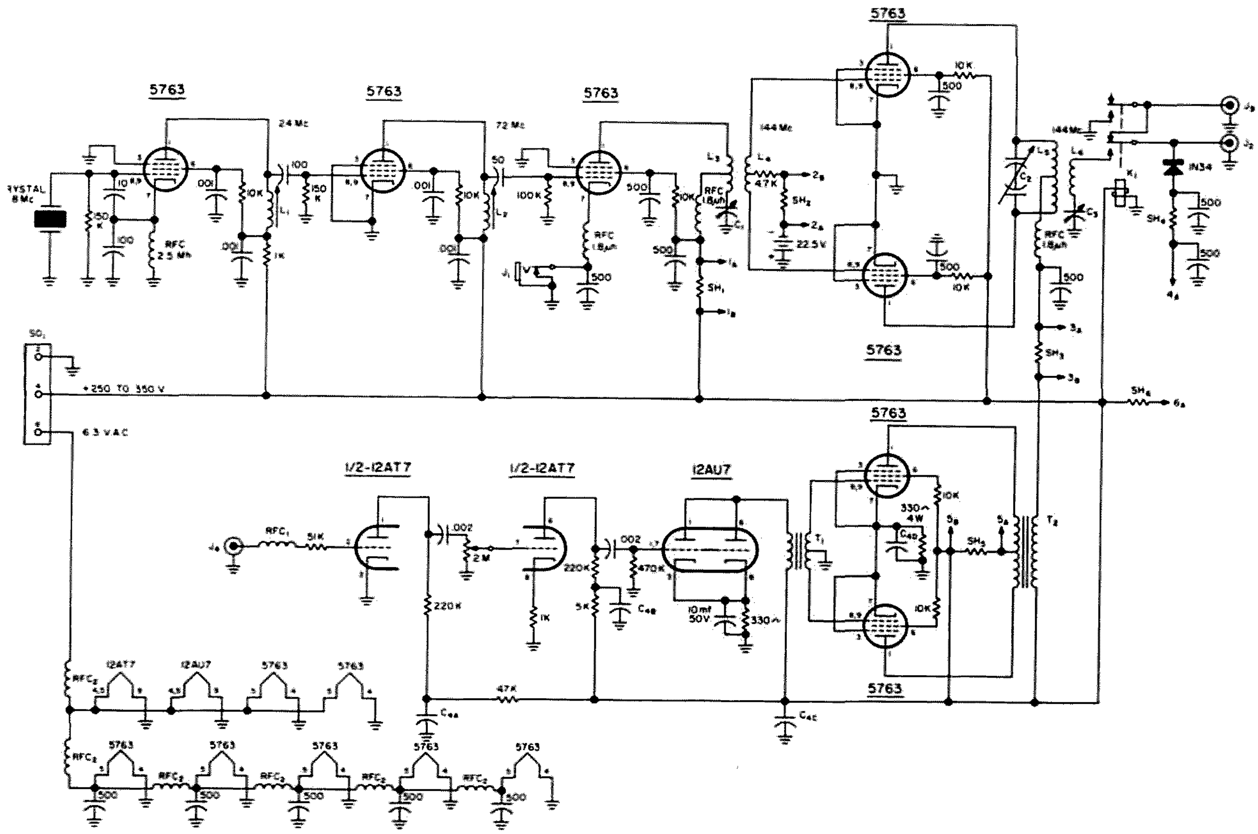
As the photographs show, I used a surplus 522 variable to resonate the final tank. Smaller components are available, such as Johnson's 3.2 to 11 mmfd butterfly dual or its equivalent. Their use would avoid using the length of the 522's capacitor stator plates as a tuned line section of the final tank, which is effectively what I have done.

Zero lead length for bypass capacitors is important at VHF. If you are in good standing with the family M.D, ask him for an old pair of surgical forceps. These look a great deal like scissors, except that their 1/16″ wide



Bulkhead and shield of flashing copper; from roofing supply house or lumber yard.

[1] Progressive Two Meter Station, Tilton, E.P., QST, October 1961.



Parts List

C_1 2.5-7.0 mmfd piston trimmer. (ceramic trimmer may be substituted)
C_2 3.3-15.0 mmfd butterfly, from SCR 522. See text
C_3 5.0-50.0 mmfd miniature variable
C_{4A-4D} Four section, each 10/450, Sprague TVL 4760
L_1 18 T #30E, 3/8" Ceramic form, Iron slug tuned, Miller #4000
L_2 5T #26E, 1/4" Ceramic form, Iron slug tuned
L_3 4 T #14, 1/2" airwound, CT
L_4 3 T #14, 1/2" airwound, CT, spaghetti covered, in center of L_3
L_5 4 T #14, 1/2" airwound, CT, prune as required to resonate with C_2
L_6 1 T #14, 1/2" airwound, CT, spaghetti covered, in center of L_5
K_1 DPDT relay, 5000 Ohm coil. Guardian 200 series
RFC_1 10 T#30E, on 1/4 watt Hivalue Resistor
RFC_2 Filament chokes, 6 T, 1/4" diameter, hookup wire
T_1 Transformer, audio driver, single plate to push pull grids, 1:4 step up See text
T_2 Transformer, modulation, 10 watt, 1:1 primary to secondary, Merit #3008
SH_{1-6} Meter shunt resistors: value as required for meter used

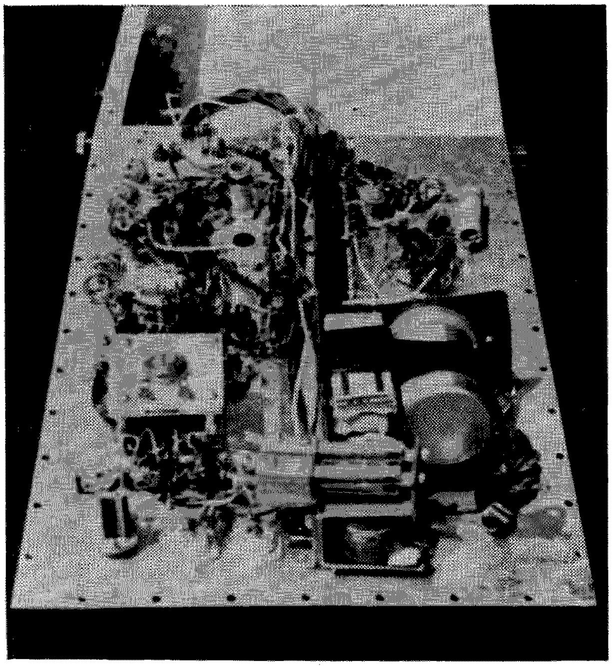
blades meet rather than cut, and they have a locking ratchet near the finger holes. With a little practice, zero length leads are easily obtained without burned fingers or the greater expense of button bypasses over disc ceramics. The locking device beats needle-nosed pliers by a wide margin.

Note in the photographs the long terminal strips on each side of the copper midline shield. Their use made it easy to check out both modulator and transmitter one stage at a time, and gave plenty of "hanging places" for meter shunts and similar components.

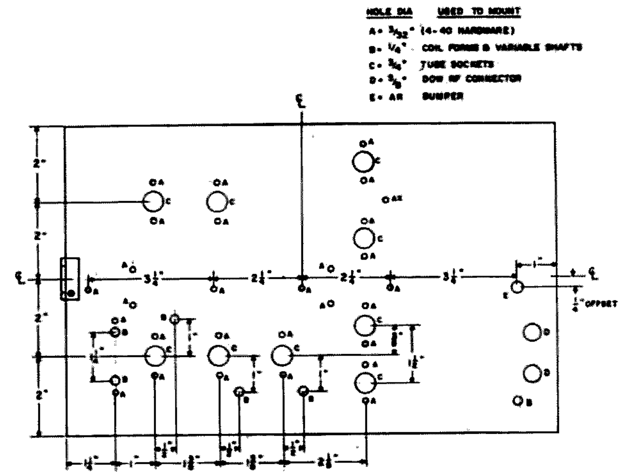
The complete modulator and transmitter rf sections are built on an 8" × 12" chassis plate, hinged at one end and secured by sheet metal screws at the other to seat in a 2½" deep 8" × 12" chassis. The copper mid-line shield separates modulator and rf sections mechanically and electrically. The space between shield and terminal strips is used as a wiring raceway.

I found it easy to lay out parts and make up a roughly accurate drilling template before boring any holes; this avoids mistakes requiring component relocation. Install tube sockets, center shield, terminal strips, modulation transformer, but leave the four section filter capacitor and its mounting bulkhead the bias battery and antenna relay until last. Wire up all components for each tube socket, running each B plus plate lead to a separate terminal on the terminal strips but not connecting them to the master B plus tie-points until each stage is ready for checkout. At *that* time, either jumpers or decoupling resistors can be soldered in place from B plus master tie-points on each terminal strip to each plate lead, but not before.

The four section filter capacitor and bias



Antenna relay, final plate tank, L_6 and C_3 in the foreground.



DRILLING TEMPLATE CHASSIS PLATE

Notes: Locate "X" holes according to dimensions of modulation transformer and p.a. plate tuning capacitor. Locate "D" holes according to component sizes. Hole "AX" in modulator half mates with cross bulkhead holding 4 section Sprague capacitor in place.

battery can go in their places with their associated mounting bulkhead after completion of the modulator tube socket and modulation transformer wiring. The bias battery is held in place both by the center shield and its frictional fit, and by a strip of insulation tape.

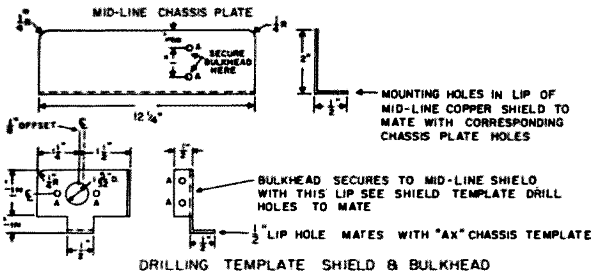
The completed unit at 20 w input requires 6.3 volts at 5 amps for filaments, and from 200 vdc at 320 ma to 350 vdc at 250 ma. Power is furnished in my installation from an outboard power supply which also contains necessary fuses, switches, pilots, and relays to give safety, and one switch control of both transmitter off-on and receiver mute-on-transmit functions. At voltages over 250, place a 5k 25w series resistor temporarily in the B plus lead to protect the tubes during tune-up.

Put all tubes in place. That threaded brass rod shown in the photographs on the output end of the unit acts as a bumper to protect tube tips from mechanical damage. Don't omit it. Check the wiring thoroughly for goofs. and apply filament voltages. Dip all coils with a grid dipper to their approximate frequencies, and tie the first stage into a B plus master tiepoint with a 1k resistor. Check the coil with the grid dipper to make sure of its output frequency. That oscillator will double to 16 mc or quadruple to 32 mc without running up a signal flag to announce its intentions. Couple a VTVM to the grid of the following stage (top of resistor through an rfc) and tune the slug in the oscillator plate coil for maximum negative dcv to the tripler grid. Or lift the ground end of the following stage grid resistor and insert an 0-5 ma meter, if you prefer. Tuneup of the tripler is identical. Remember that its output frequency must be checked at 72 mc. It also will quadruple if you are not careful.

The final grid coil is tuned only by the tube input capacitances and should be soldered in place and dipped to 150 to 160 mc before the driver plate coil is put in place. Change the frequency of this coil by squeezing or spreading turns until it dips out as close to 150 mc as you can get it. With driver plate coil in place and voltage applied to the driver plate, tune the plate of the driver with C_1. After obtaining maximum p.a. grid readings, adjust the position of the final grid coil relative to the driver plate coil for optimum coupling and maximum energy transfer until all possible has been coaxed from the driver stage. As little

Stage	Grid MA	Plate MA	Grid Volts at 250 Plate Volts	Where Read
5763 Osc	—	17	— 15 VDC	Grid pin (Crystal current)
5763 Tripler	2.8	28	— 170 VDC	Grid pin
5763 Doubler	2.1	32	— 130 VDC	Grid pin
5763 PP PA	3.2	88	— 52 VDC	Top of 4.7K resistor
12AT7 Sp Amp	—	—	40 VAC	Pin 7
12AU7 Driver	—	—	120 VAC	Driver Xformer Secondary
5763 PP Mod	—	30/94	—	—

Typical voltage and current readings.



Drilling template, shield and bulkhead.

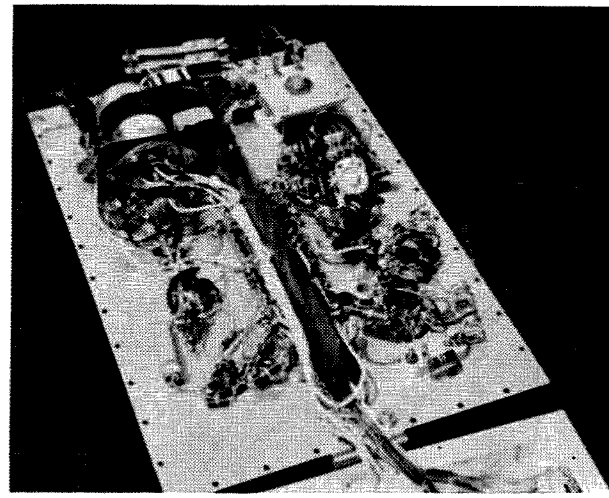
s 0.3 ma (or −28 vdc bias) can be used, ut 3.0 ma is required for full input and is ot hard to obtain.

To set up the final, use a dummy load onsisting of a #47 (blue bead) lamp and 1 turn coil loosely coupled to the final tank. Vhen resonance is established, increase the oupling if you desire, to obtain good bril- :ance, and retune all stages beginning with he oscillator for maximum lamp brilliance nd proper plate current to the final. Remove he dummy load, switch the meter to read rf ›ut, connect the antenna, tune out the anten- ıa feedline reactance with C_3 (similar to load- ng a pi-net), maintaining resonance with C_2, nd your rf section is on the air. If you have :hecked each stage with the grid-dipper in vavemeter position, you are on the right ›and, too.

The audio section is easy. Beginning with he input stage, connect the decoupling resis- ors between tie points and plate load resistors or transformer primaries) one stage at a ime. Either use the VTVM tied to .01 block- ng capacitors temporarily soldered to plate ›ins, reading af volts to ground with the /TVM, or use headphones and GOOD ›locking capacitors across each plate to ;round. Crank up the gain and watch for ıudible or visual indication as you talk into he mike. The headphone system also gives ı check on audio quality, but if you use it, be :areful to keep B plus away from that low esistance ear-to-ear electrocution path.

The modulators are in Class AB_2 with the ndicated value of cathode bias. They could ›e run in Class B using fixed bias supplied rom the negative battery terminal to the :entertap of the driver transformer secondary, f it suits you better. Either arrangement gives ;ood performance and good audio. If you lack ı suitable driver transformer, see the audio ;ection of the ARRL handbook and rig up he 12AU7 as a phase inverter to drive the nodulator tubes in Class AB_1.

The −22.5 vdc bias applied to the final ·educes key up current for CW to a very ow value, well within the plate dissipation :apability of the tubes, but does not cut the


Bottom View

final plate current to zero. The serious CW man will provide a system for shorting out the modulation transformer secondary. My listeners on two meter CW will simply have to put up with whatever inductive "tails" my characters have on infrequent 2 meter CW contacts.

No provision is made for neutralization, since the final amplifier as configured here was stable without provision for it. With other components, such might not be the case. If final instability appears in a modified configuration, standard screen neutralization of each 5763 ought to produce stability.

For those who might wish to try a copy but don't care to duplicate mine exactly, or who prefer to experiment with components, the following suggestions are made:

Try a 6CL6 oscillator. Use link coupling. Make it all 5763's, including both speech amplifier and audio driver. They work, and this reduces the callout for spares in the tube locker. Use 6AQ5's for modulators—watch your matching impedances. Use airwound coils and variable capacitors in the rf circuits instead of slug tuned forms. Omit metering circuits except the relative rf output and final grid drive. Use closed circuit jacks and a plug-in type meter. Use a single 5763 final amplifier with appropriate changes in driver plate and final grid and plate tank components. Ten watts on two with a good antenna will let you work all you can hear except genuine two meter DX for which 100 watts or more is needed.

The 5763 seems to have gone relatively unnoticed as a two meter final, and it has merit in modulator service. A pair of them are capable of 20 watts input at 144 mc at reasonable efficiency, and are less expensive than tubes specially designed for the VHF bands. . . . WA6SIZ

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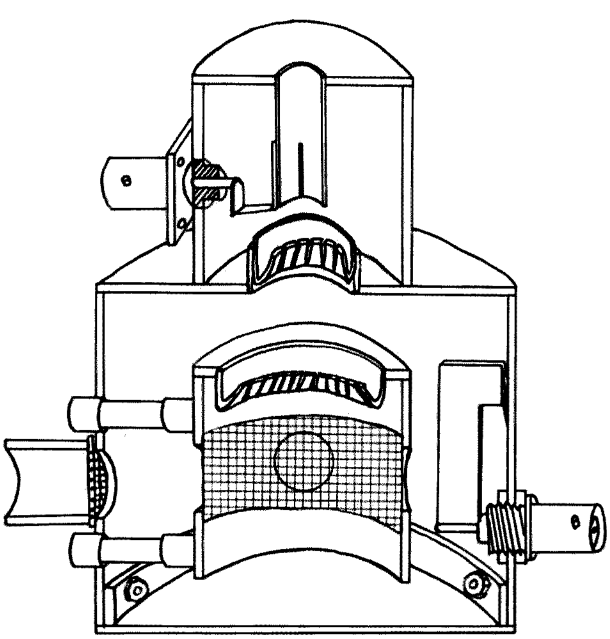
2C39 Amplifier for 1296 mc

Bill K1CLL suggested in one of his recent articles that the 2C39 would make an ideal amplifier for 1296. Some time ago, I picked up some 2C39's for seventy-five cents apiece, so Bill's suggestion prompted me to design the amplifier described in this article. I designed the amplifier as I went along, with suggestions for construction coming from the APX-6 cavities.

I tested this amplifier with a 350 volt power supply. The first testing was done before final construction to determine the frequency without any tuning. The output was coupled to the input through a slotted coax line indicator to make the amplifier into an oscillator. The measured frequency was 1365 mc. This was considered close enough so I continued the construction to the end. Final testing was done with the drive from a APX6 and a 15 watt lamp as a load. I was able to get a 35 watt input to the amplifier. The output was not measured but must have been a fair percentage as the 15 watt lamp had a nice glow. At this frequency I would guess that the output may have been as much as 20 watts.



Cut out view of 1296 amplifier.

The 2C39 is an air cooled tube and building it into the cavity created a cooling problem. The cavity and plate line were drilled with one half inch holes that were covered with copper screen wire. This allows air flow from the input port to the other port. Both ports are made of one half inch copper tubing. The XYL better keep her eye on the vacuum cleaner.

It is necessary to use soldering flux and 60-40 solid solder wire. If regular core type of solder is used it would make it most difficult to clean. Lots of heat should be used and if you don't succeed the first time pick up the pieces and start over again.

You will notice as you put this amplifier together in sequence that seldom will the heat give you problems.

The finger stock was from some sort of a socket in a piece of surplus equipment but could be easily made from brass weather stripping. Plate stock can be obtained from copper pipe split and flattened out.

Construction Sequence

A. Plate line.

1. Cut a piece of 1½ inch copper water pipe 1½ inches long.
2. Drill four ½ inch holes 3/4 inches from either end spaced 90 degrees apart.
3. Tin inside of line.
4. Cut a piece of copper screen wire 3/4 inch by 4 3/4 inches.
5. Tin and solder inside of line over the ½ inch holes. (This will provide vents for the 2C39.)
6. Construct an end plate from 1/16 inch plate.
7. With a 1¼ inch hole punch out a 1¼ inch hole in end plate.
8. Center the line over the end plate and solder.

9. Pre-shape some finger stock and cut a iece to fit inside the end plate.
10. Solder the finger stock and dress up verything already done.

·. Plate Cavity

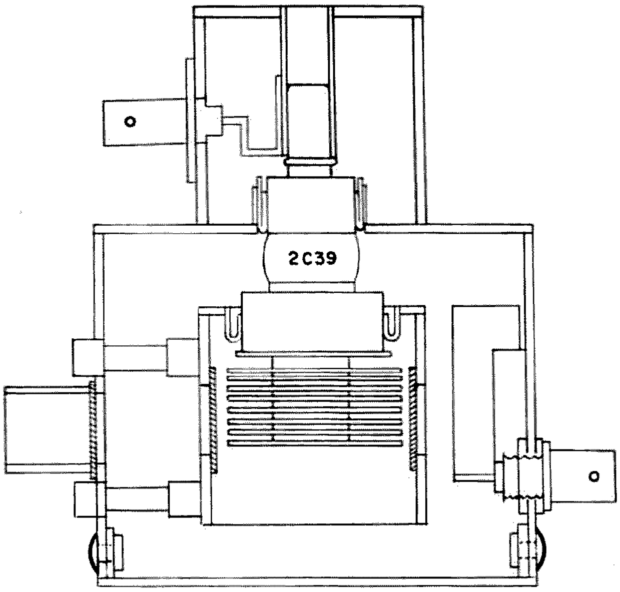
1. Cut a circular piece of 1/16 inch stock inches in diameter.
2. Punch a 3/4 inch hole in middle of this inch plate.
3. Cut a ¼ inch ring from a brass miniature ıbe shield. (This ring is to keep the finger tock's shape.)
4. Cut a piece of finger stock to fit inside f the above ring.
5. Fit the above over a piece of ½ inch pipe, enter the works over the 3 inch plate and older. (Do not solder the ½ inch pipe.)
6. Cut a piece of 3 inch pipe 2½ inches ɔng.
7. Center and solder end plate over this 3 nch pipe.
8. Remove the ½ inch pipe and dress things ıp.
9. Drill holes per template.
10. Cut two pieces of ½ inch pipe 1¼ inches ɔng.
11. Cut two pieces of copper screen 5/8 nches in diameter.
12. Sandwich the 5/8 inch diameter screen ›etween the outside of the 3 inch cavity and he 1¼ inch length of ½ inch pipe. Center ıver the ½ inch holes in the cavity. Hold in ›lace with a "C" clamp and solder. Do this ın both sides of cavity.
13. Use an old 2C39, place plate line over ube and insert tube into cavity deep into the grid fingerstock.
14. Center plate line and solder in place 3 auto fuses that have been deliberately ›lown. (AGX type is just the right length.) Note: At this point it is very difficult to older the fuses to the rear of the plate line, ›ut that will be FB even if you can't. You ɔan remove tube after you get a few spacers n place. Using fuses in this fashion makes a eal sturdy device.

C. Output pickup loop. See **Fig. 1**

1. Cut a piece of brass shim stock per letail 1 and form.
2. Add output BNC fitting UG-625A/U or ıse your choice of fitting.
3. Using a soldering iron solder the pick-up oop to the fitting.
4. Heat cavity with torch from the outside and solder the loop to the cavity.

D. Cathode Cavity

1. Cut a piece of 1½ inch pipe 1⅜ inches ong.



Amplifier with 2C39 in place.

2. Drill a ⅜ inch hole 11/16 inch from either end.

3. Put 2C39 (old one that is) in place.

4. Center and solder the 1½ inch pipe to top of plate separating the plate cavity and cathode cavity.

Note: This is the only place that I had trouble. I lost my grid finger stock and had to get it resoldered in place.

5. Solder a chassis type connector over the 3/8 inch hole in the cathode cavity. (The flange can be removed if you like.)

6. Cut a piece of 5/16 inch inside diameter tubing 1 inch long.

7. Cut 4 slots 90 degrees apart 7/16 inches deep in one end of the above tube.

8. Cut a piece of shim stock 3/16 inches wide and ⅞ inches long. Shape per detail #2.

9. Solder detail #2 to the above tube which we can call the cathode cap. (Be careful here not to fill any of the slots.)

10. The 2C39 was installed in item D-3. If it isn't, install it now.

11. Place cathode cap over cathode of tube and solder detail #2 to the connector.

12. Cut an end plate 1½ inch in diameter.

13. Drill a ⅜ inch hole in center of this end plate.

Note: It is very important at this point that the ⅜ inch hole is a sloppy fit over the cathode cap. If it isn't, rat-tail it until it is sloppy. This is to prevent heat traveling from the end plate to the cathode cap.

14. Solder end plate to cathode cavity.

15. While end plate is still hot solder cathode cap. (It would be wise to cool the end plate with a wet rag as soon as you can after soldering.)

E. Tuning (Fine). See Fig. 2

1. File the head of a round head 6-32 by 1 inch screw until very little is left.

2. Cut a ½ inch disc from brass shim stock

3. Center disc on the above 6-32 screw and solder.

4. Solder a 6-32 nut to the outside of the plate cavity at point C 1 on the template

5. Cut the screw length down to the longest length that will fit between the plate line and cavity.

6. Cut a screwdriver slot in end of screw

7. Install screw.

F. Tuning (Coarse). See Fig. 2

1. Solder a 6-32 nut to the outside of the plate cavity marked C2 on the template.

2. Choose a piece of spaghetti to fit over a 6-32 screw and cut a piece ⅜ inch long.

3. Choose a piece of brass tubing that will fit over the above spaghetti. Cut a piece ½ inch long.

4. Remove the 2C39.

5. Put spaghetti inside tubing.

6. Run a 6-32 screw down through the "C2" nut, through spaghetti almost to the plate line.

7. Solder tubing to plate line.

Note: Both condensers are locked in place after tuning by lock-nuts.

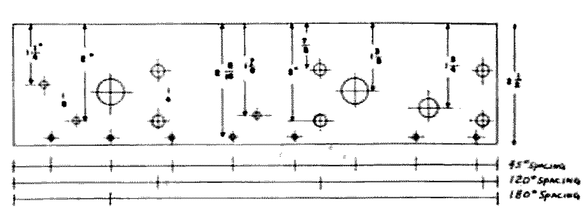
G. Plate cavity base cover.

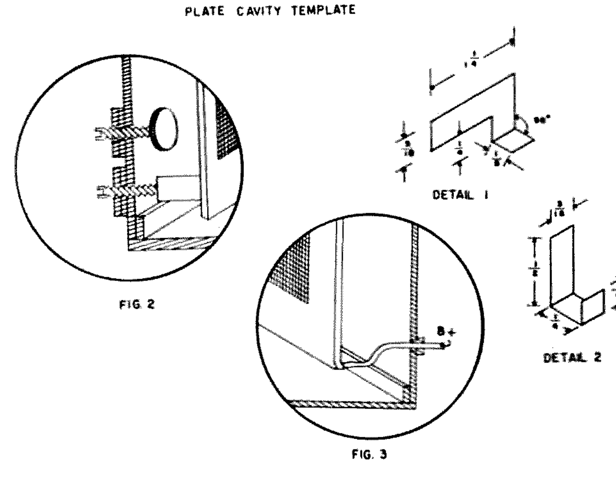
1. Cut a piece of 3 inch pipe ⅜ inch long.

2. Cut out a piece ⅜ inch wide and reshape to fit inside a 3 inch pipe.

3. Cut a plate 3 inches in diameter.

4. Center and solder the two above items together. This will make a cup-like structure.





Details of construction.

5. Drill holes to match base holes shown
on template.
6. Solder 6-32 nuts inside of the ⅜ inch
ring.
Note: To aid in soldering, a ¼ inch piece of
3 inch pipe may be slipped over the ring and
removed after all soldering is completed.
H. Plate power. See **Fig. 3**
1. Install a teflon bushing and feed-through
or something similar in the hole marked B
plus on the template.
2. Connect a 4 turn #22 guage ⅛ inch diameter RFC from feed through to the base of
the plate line.
. Heater
1. Cut a piece of ¼ inch tubing 1½ inch long.
2. Slot tubing several times and reduce size
fit heater.
3. Add one layer of plastic tape to insulate
heater from cathode.

This amplifier with a feed-back loop added to the plate cavity and coupled back to the cathode cavity would make a nice oscillator. Feed this oscillator into another amplifier of the same kind and add plate modulation. Then you would have a FB transmitter for 1296 mc. This would really give you a good start for a home brew 1296 mc station.

. . . WA8CHD

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Varactor Tripler to 1296 mc

With quite a few varactor triplers being used here in the Los Angeles area on 432 mc, an easy way to get on 1296 with a clean stable signal is to add another varactor tripler.[1] The tripler described here takes 5 watts input at 432 mc of FM or CW and triples it to 1296 mc with an efficiency of 40% or 2 watts output. AM can be tripled but the maximum input power cannot exceed 3 watts. The output can be used to drive a 2C39 type amplifier for higher power. The total cost using all new parts is less than $25.00.

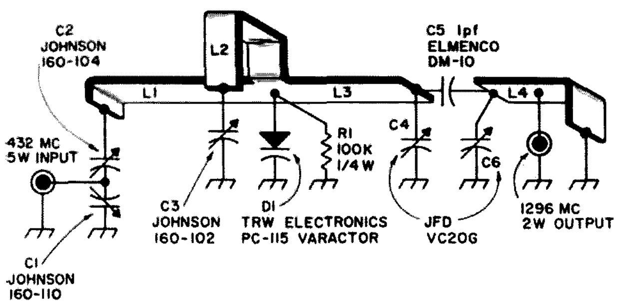
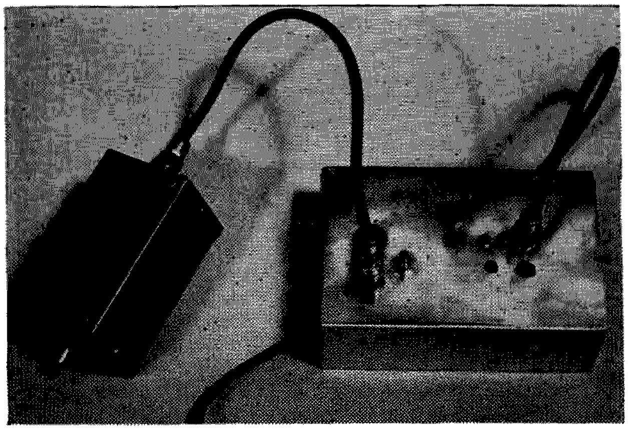


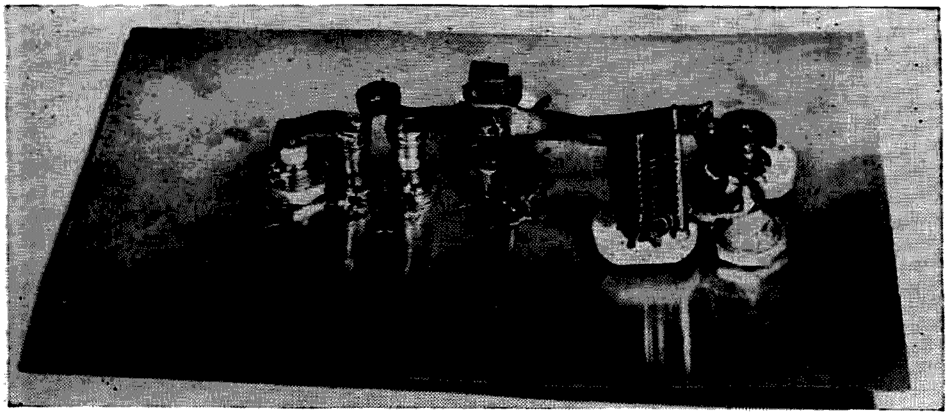
Fig. 1. Schematic of varactor tripler to 1296 mc.

1. Varactor Tripler to 432 mc/s, 73 Magazine October 64.



Tripler to 1296 driven by tripler to 432 (left).

L1, C1, C2 are tuned to 432 mc and match the 50 ohm input to the varactor impedance. L2, C3 is series tuned to 864 mc as an idler so that the 2nd harmonic energy is circulated only through it and the diode to mix with the fundamental. L3, C4, and L4, C6 are two tuned circuits at 1296 mc to select only the 3rd harmonic energy, clean it up, and match to the load. Cavities can be used fo less circuit loss and greater parasitic suppression but the added cost and effort does not seem to justify the slight improvement. The resistor R1 provides a DC return and self bias



Layout of varactor tripler. 432 mc input is on right with 1296 mc output on left. Varactor can be seen in center in front of idle components. Note tw extra holes.

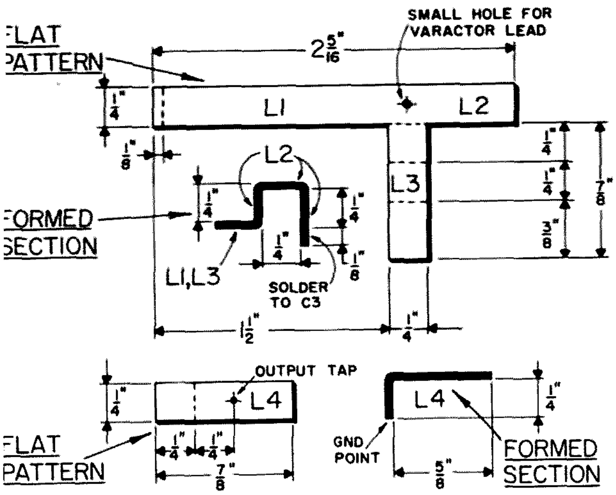


Fig. 2. Patterns of inductors.

or the varactor so no power supply is neces-
ary.

The cost of varactors jumps up sharply for nput frequencies above 400 mc and powers ibove 5 watts. The PC-115 is $12.00 and for owers up to 16 watts input a TRW Electronics (formerly PSI) PV-002 for $16.00 can be used. recommend the PV-002 if you use the Hybrid 432 mc Exciter (March 65-73) which s a great rig. They are available through most nail order parts houses. Newark Electronics it 223 W. Madison St., Chicago, handles the varactor. *Care must be exercised* if other varactors are used since dissipation, efficient requency range, and impedance are very dis-rete.

Cut out the inductors as indicated in **Fig. 2** rom a piece of sheet copper.

Construction

Layout the brass board as shown. The board tself takes the place of the bottom plate on a 4 × 6 × 2 box chassis.

Refer to the pictures for parts placement and position. The varactor holder is made rom a Cambion PLS6 coil form. If a PV-002 s used the form is not necessary since it is

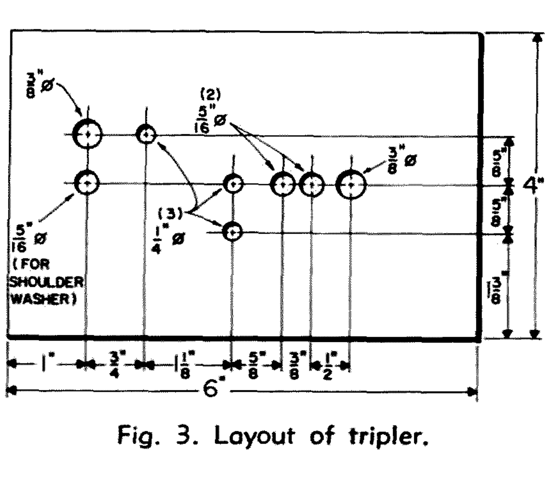


Fig. 3. Layout of tripler.

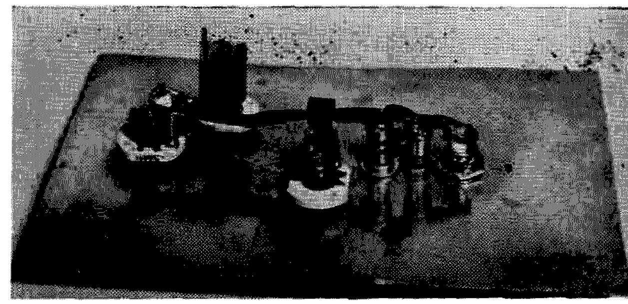


Photo of varactor tripler.

a stud mount. Break off the ceramic and take off the spring clip.

Mount the varactor holder on the board. Gently place the varactor in the holder with the brown band down. You may have to spread the holder fingers a little. Do not force the varactor in as the glass case is fragile. This holder provides a simple but effective ground and heat conductor for the varactor. Assembly from here on is straight forward. Make sure that the rotor of C2 is not grounded from improper seating of the fiber shoulder washer. The cold end of L4 is soldered to the BNC chassis connector body. Solder the hot lead of the varactor with no more than a 47 watt iron using care not to over heat as you would for any semiconductor. The JFD Variable Capacitors are fragile but they are the only ones that are good at this frequency. Take care when soldering around the top of the capacitor and L3 and L4.

Tune Up

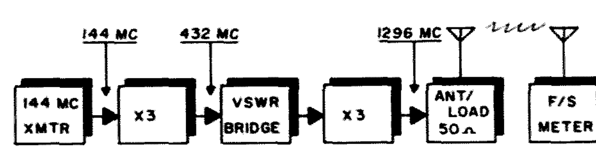


Fig. 4. Tune-up procedure.

The best way to tune up any varactor multiplier is to tune for the lowest VSWR between it and the generator. When properly tuned and matched, maximum power output and minimum VSWR coincide. It is assumed however, that most hams will not have a VSWR bridge capable of operating up to 432 mc so a field strength meter and the old method of "tune for maximum smoke" can be used. The L and C combinations have been chosen such that the wrong harmonic does not fall into any of their ranges. Each adjustment affects the other, so touch up each capacitor several times.

Now you're ready to get on the air on 1296 mc. Remember not to exceed the power rating of the varactor. Good DX'ing.

. . . W6ORG

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CPO–CWM

The unit shown in the photographs and diagram (Fig. 1) is designed to be used as a code practice oscillator, and also as an off-the-air cw monitor. It utilizes two transistors, one PNP and one NPN. Also included are one diode and several small parts.

My particular unit is built into a small Mini-box that is 3¼ x 2⅛ x 1⅝. It contains a built-in speaker and key jack as well as the oscillator. The battery, which is used only for code practice, is also inside the box.

As can be seen from the photos my unit is built on a printed circuit board. This simplifies construction and makes a neat and sturdy job.

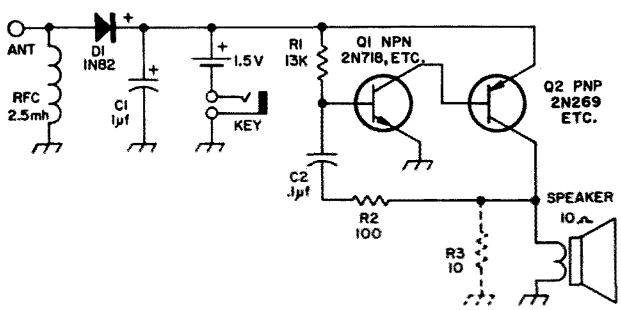
The speaker and key jack are mounted on the front panel and while no dimensions are shown (your speaker may have different mounting holes) the general layout of the panel can be seen. On the right-hand end of the box are mounted a ground lug and antenna terminal.

The parts are not too critical. Capacitor C2 may be anything from .01 to .25 μf. The larger the value, the lower the tone. C1 is shown as being 1 μf in value, but it may be anything up to 50 μf. The value of CI will only effect the tone when the unit is being used as a cw monitor.

When used as a monitor it is only necessary to connect the case to the station ground, and a short wire to the antenna terminal. No adjustments or tuning are necessary.

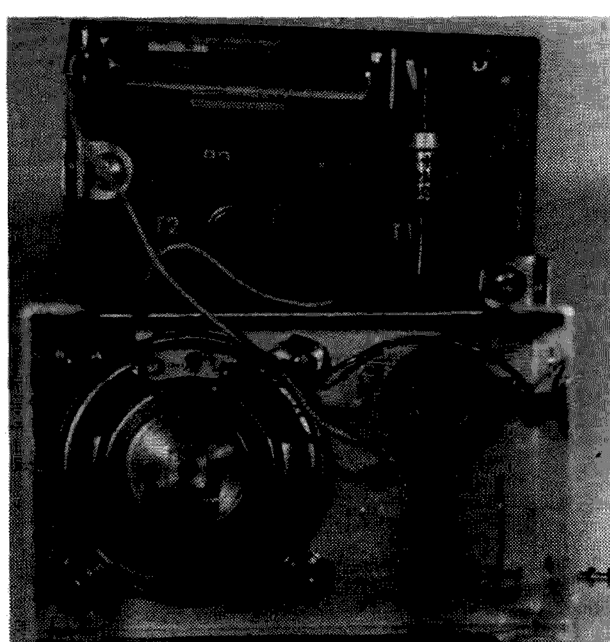
As for the transistors. A type 2N718 and type 2N269 were used in my unit but only because they were types that I had on hand. You may use almost any type as long as one is PNP and the other NPN.

A word of caution as far as the speaker is concerned. Aside from getting one that will fit into the case, try to get one with a voice coil that is 10 ohms or less in value. If your speaker happens to have a higher resistance than 10 ohms it will be necessary to connect

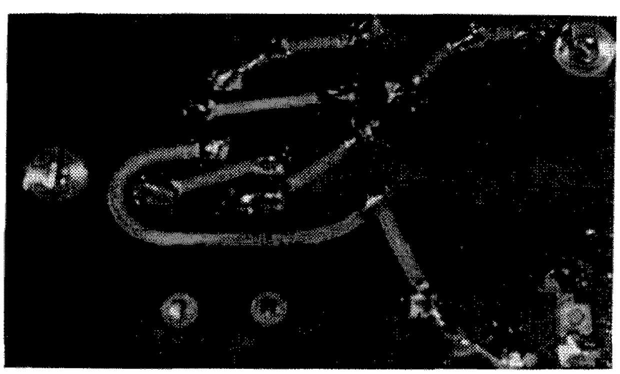


Parts List

RFC—2.2 mh RF Choke
C1—1 μf 10 volts
C2—.1 μf 10 volts
D—1N82 diode, etc.
R1—13 k ½ w
R2—100 ½ w
T1—2N718
T2—2N269
Speaker, key jack & misc. hardware
Cabinet is Premier AMC 1001
Battery is Eveready 912



Inside view of the Code Practice Oscillator and CW Monitor.



Copper side of the printed circuit board. It's available for 50c; see note below.

a 10 ohm resistor across the voice coil. If this is not done, the unit will not oscillate.

So . . . go ahead and spend an hour or so of your time. Build one of these gadgets and be able to tell what your keying really sounds like (you may be surprised). It's also useful as a group code oscillator and has plenty of volume.

. . . W1JJL

A printed circuit board for this useful project is available for only 50c from the Harris Co., 56 E. Main, Torrington, Conn.

Joe Williams W6SFM

VHF Flashback

Is it possible that a single vacuum tube, a particular circuit or a certain ham could cause a big upswing in VHF activity? Probably not—but if we take the three and add them together just right the chances improve. Back in 1934 Frank C. Jones W6AJF, wrote a booklet called "5 Meter Radiotelephony"; that little 25c paperback was the most complete treatise on VHF of its day and it triggered an outburst of VHF interest that has not yet subsided. Five meters lay from 56 to 60 megacycles and was "the" VHF band before those frequencies were given over to the marathon Punch and Judy rattle that we now call Channel Two. Jones, with his usual prescience, featured a one tube 5 meter transceiver using a type 19 tube. The 19 was, to the author's knowledge, the first instance of two tubes being packaged in one glass envelope; this little jug boasted a low current 2 volt filament and was as microphonic as a tuning fork. We used to start them with a flashlight cell and then let plate current flow keep the filament glowing while we rested the "A" battery. In those days a flashlight cell cost a whole nickel. The rig that was described in Frank's booklet used a plate tank made of quarter-inch copper tubing with the grid coil cleverly threaded inside the tubing. The circuit bore a very strong family resemblance to the Eccles-Jordan multivibrator and this at a time when those gents had hardly met.

The whole thing was laid out on a real breadboard and used a king-sized porcelain based d.p.d.t. knife switch for the send/receive control. An evening's work on that switch was almost equal to a trip to the local gym. The super-regen receiver was surprisingly sensitive and was complete with a wavering radiated whistle that usually out-DXed the transmitter. The circuit in the transmitting state was grid modulated and would light a #47 pilot lamp on a loop while the modulation was checked by observing brilliance variations that accompanied whistling into the mike. The grid modulation worked better than it had a right to but somehow the carbon mikes got hot and turned out to be real lip burners.

Those were exciting times and new "discoveries" were being made almost everyday by an eager VHF crowd. The most baffling ionospheric vagary of those days was the fact that 5 meters would go stone dead each evening at 7 pm. Not a peep. Then somebody tumbled to what should have been an obvious cause. The VHF stalwarts, along with most of the balance of the population, dropped everything to listen to Amos 'n Andy on the radio.

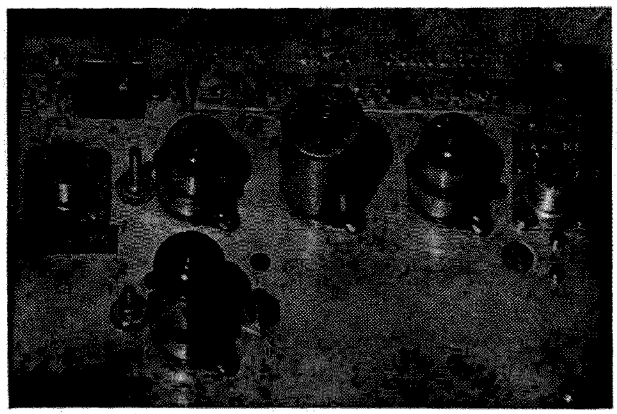
If you run across a copy of "5 Meter Radiotelephony," thumb through it and you will find information on Rhombic antenna design for VHF; A modern Link-Coupled Phone with a type 46 in the final; How to run a pair of 210's in a stabilized 5 meter transmitter; An explanation of Superregeneration; The Franklin antenna, a vertical colinear that could have some current pragmatic value on Six; Measuring the Wave at 5 Meters and a description of a rig using an Armstrong-Dow oscillator.

One of the most interesting things about looking at old publications is the advertising that appears in them. "5 Meter Radiotelephony" is no exception. It may come as a surprise to some to learn that even in those days transceivers bearing the name Knight were available from Allied Radio. Other transceiver producers were National and Harvey. The Collins Radio Company, which termed itself "Designers and Manufacturers of Transmitters, Transformers and Speech Equipment" offered quite a collection of audio transformers priced at an unbelievable Two Bucks each. Other names, still known today, pop up in ads and in the text. Some of them are: Stancor,

Raytheon, Thordarson, Burgess, I.C.A., Newark, RCA, Walter Ashe and Amperite.

Just for the ducks of it, the type 19 transceiver was built here at W6SFM a few months ago. A few little changes were incorporated into the make-up but the design was left just the way Jones had described it back in 1934. For instance, instead of a 19—a pair of 7586 Nuvistors were used and a toggle switch replaced the old blunderbuss d.p.d.t. The copper tubing bit was duplicated exactly except that this time the grid winding was teflon insulated. A slightly larger tuning capacitor was used and it fell into six meters with ease. The receiver is a gas! Those Nuvistors really play loud. A sked was arranged up in the FM section of the band and WA6EOY reported that the rig, carbon mike and all, was crashing through at about umpty-ump db over Gangbusters. All this has given me the courage to make something that I've been wanting to try for quite a spell: the W6AJF rig condensed down to hand holding size. Figure to use a couple of lucky 2N711's and a toroidal tank. Ought to make a great little local FM net rig. I'll let you know if it works.

. . . W6SFM



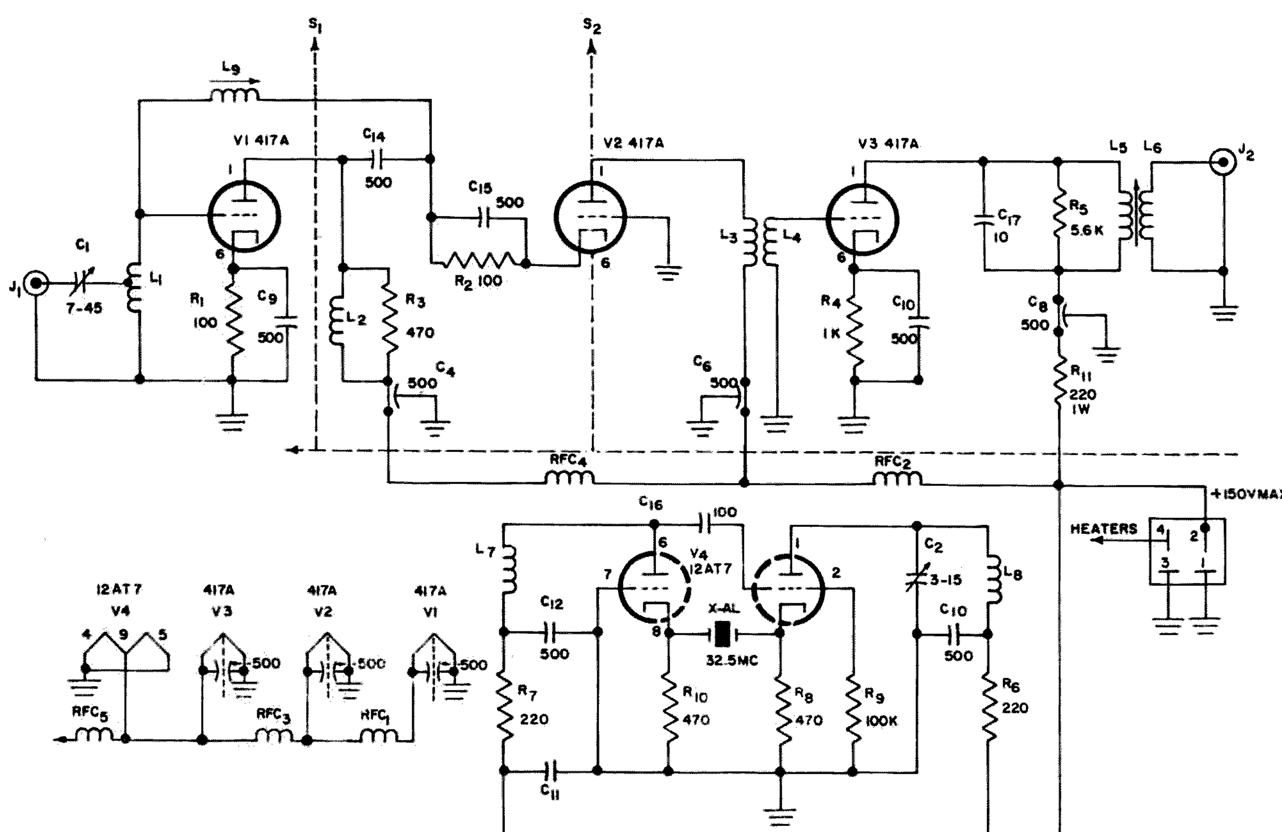
Stanley J. Plager K2KTV
55 Windsor Avenue
Rockville Centre, New York

Seeking the ultimate on two

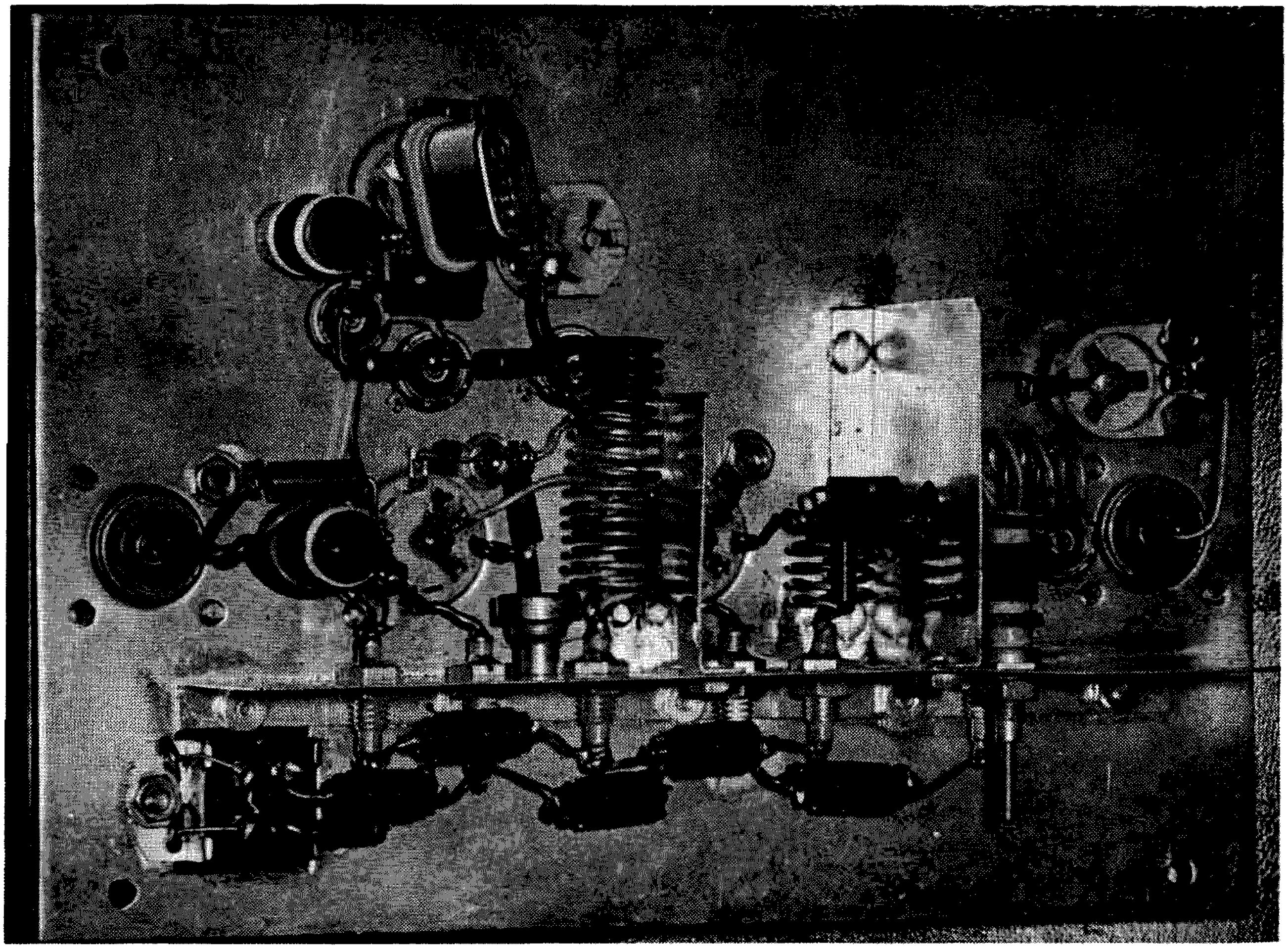
Silverplated 417A Converter

This is an attempt at an ultimate 144 mc converter using present day components and techniques. This attempt was sparked by availability on the surplus market of the Western Electric 417A triode. The 417A, with it's golden grid, is considered one of the finest VHF receiving tubes ever made. A noise figure of 2.5 db has been realized with this converter, but only after the utmost care was exercised in construction, alignment and trouble shooting.

It is recognized that several of the com-



Schematic of silverplated 417A two meter converter.



Bottom view of 417A converter. Antenna input is at right with neutralizing coil beneath airwound input coil. Oscillator is at top. *If* output is jack on left.

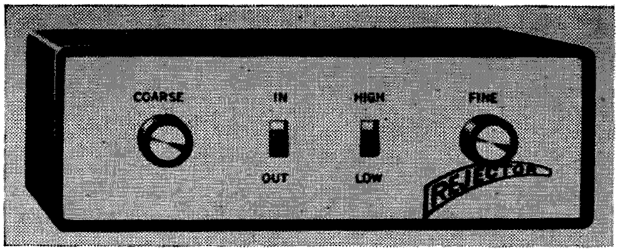
ponents specified herein could be replaced with less expensive items, but in attempting to achieve an extremely low noise figure, it was felt that cost was secondary within reason.

The converter plate when completed is screwed to the lip of a modified and inverted five by seven by two inch aluminum chassis. All wiring must be kept to a minimum. All 500 pf capacitors are mica feed-through or button. Feed-through capacitors should be soldered to the shield partition S3. The threaded type may not make good contact unless soldered. It may be found necessary to use 1000 or 1500 mmfd feed-through capacitors. To check for positive bypassing, touch the bypassed circuit at the capacitor with the converter in service. There should not be any noticeable change in noise or signal strength. L9 is the neutralizing medium for the triode first rf stage and is tuned in the following manner. Locate a strong signal and disconnect the filament of the first 417A. This is easily accomplished by cutting off half of pin 9 on the 417A tube. Loosening this tube in its socket will break the filament connection. Adjust L9 for minimum signal, lock setting in place and reconnect the heater or firmly seat VI. This circuit requires no further adjustment.

The 7-45 pf antenna trimmer is adjusted for maximum signal—not maximum noise. A small shield may be required between L-7 and the L-3 L-4 L-8 group to reduce interaction.

Coil Chart:
L-I 3T #18 bare 3/8" I.D. tapped in center
L-2 5T #18 bare 3/8" I.D.
L-3 6T #18 bare 3/8" I.D.
L-4 3T #18 bare 3/8" I.D.
L-5 Slug tuned broad band I.F. coil tuned to 14 Mc. (38T #26 enamel on 3/8" Slug Tuned form)
L-6 4T #22 bell wire over cold end of L-5
L-7 15T #22 enamel on 3/8" Slug Tuned form (resonant at 32.5 MC)
L-8 4½T #18 bare ¼" I.D.
L-9 11T #22 enamel on ¼" Slug Tuned form.
RFC 1-5 14T #22 enamel on 220K Ohm—1 Watt resistor
L-3 L-4 L-8 are in line end to end with L-4 in center; loose coupled.

. . . K2KTV



Charles Leedham WA2TDH
101 West 23rd St.
New York, N. Y., 10011

Testing the Galaxy Rejector

About the only thing that has ever made me unhappy about my nice new SSB equipment is that the receiver doesn't have a notch filter. This is by no means unusual—few receivers or transceivers do have notch filters built in. Install one? Even though this confession may reveal me to the world as a rotten appliance operator, I have never felt up to designing, building and installing one somewhere inside the guts of the little box. Tsk. But just recently, Galaxy came up with the gadget I'd been wishing all along somebody would make—a notch filter that goes into the speaker line.

The *Rejector* is an all-transistor audio filter which tunes across the audio spectrum from 300 to 5,000 cycles. Within that range, it will knock any ten-to-twenty cps segment down 40 db, effectively removing it from what you hear in your speaker. Thus when you are listening to a nice signal and the usual heterodyne starts blasting your ear, you no longer mutter and curse the schlunk who's throwing it on you. You flip the Rejector on—when off, the unit is completely out of the circuit—and tune the "Coarse" control until the notch is centered on the heterodyne. The heterodyne will disappear. If you don't hit it exactly with the "Coarse" knob, there's a "Fine" control knob for more precise adjustments, but I've hardly ever needed it.

In operation, the Rejector is a handy gadget to have on your operating table, as it can be made to do considerably more than just eliminate heterodynes. On CW, it will knock an interfering signal, if not completely out, at least far down enough to make the desired signal easy to read. And on SSB it can be a blessing for reducing interference. If, for example, you're listening to a contact, and someone else comes on a kilocycle or so away, you can edge the notch around to depress the high audio frequencies of monkey chatter, or the low audio of rumble. In one or two cases, I have even been able to get usable copy from one station with another on essentially the same frequency—if one guy's voice is enough higher or lower than the other's, it is possible to use the notch to depress either the higher or lower voice. Obviously, nothing can completely eliminate the unwanted voice in this kind of situation, but the Rejector can make the difference between copy and confusion.

Even on single signals it can be useful. Trying to copy weak DX signals, I've been able to swing the Rejector's notch down to cut out some of the lower voice frequencies (plus at least a small hunk on the QRN) and make relatively easy copy of it by getting only the higher and more penetrating parts of the voice.

The unit is small (7½ by 5¾ by 2¾), attractive, and has a reversible front plate so that you can use it horizontally, sitting on top of your receiver, or vertically, standing between units or alongside. It is simplicity itself to hook up. Two cables are supplied with pin-plugs (RCA phono type) on each end. One goes from your speaker socket on the back of the receiver to the back of the Rejector, and the second cable from the Rejector to the speaker.

Power required is 12 volts at half an ampere, AC or DC, which can be taken from the auxiliary power socket of many transceivers and receivers. If yours doesn't supply 12 volts, it is easy enough to whomp up a little AC supply with a filament transformer and a switch mounted on a minibox. Or, if you like, Galaxy sells a small 12-volt supply for $6.95.

If you've never used a notch filter, you'll be astounded at what a difference it can make in your reception. And even if you already have a notch in your receiver, by the way, the Rejector can add a second notch, to take out the interference above the signal while your internal notch is handling the stuff below. It's a good little unit, and, for $34.95, is well worth adding to your equipment. . . . WA2TDH

William Welsh WA6VTL

20 WPM—or Bust!

If FCC Docket 15928 becomes a way of life in amateur radio (and it probably will), thousands of Conditional, General, and Advanced hams will make every effort to upgrade to the Amateur Extra Class License so that they won't suffer any code or voice operating restrictions. It's quite possible that some parts of the published docket will be changed before the new regulations take effect but it does seem likely that Amateur Extra Class licensees will enjoy exclusive (or semi-exclusive) code and voice operating privileges. This article will help you upgrade yourself to the point where you'll be able to pass the code portion of the Amateur Extra Class license examination.

It is assumed that you hold a valid Conditional, General, or Advanced class ticket and that you've held it for the required two years, or more. If the Amateur First Class License becomes a reality, this article will help take you to the 16 WPM code requirement for that class of ticket. It is assumed that you will be striving for the top license, though, and this article will help you achieve that goal.

In case my current call sign (WA6VTL) bothers you, I'll take this opportunity to assure you that I know licensing programs. I've taught free general class licensing courses for 14 years. My time has been divided between the El Ray (W1OMI), Middlesex (W1HEB), Salem (K1HDZ), and Lockheed (W6LS) amateur radio clubs. In addition, I've taught ham courses for schools, scout groups, CD groups, industrial recreation groups, boys clubs, etc. Due to the fact that I've been able to make most students realize that there's no substitute for study and effort, I've been able to help thousands of students get their tickets. You'll find that you'll be helped, if you follow instructions.

As you probably know, the Amateur Extra Class License code test requirement is 20 wpm. If you are an amateur who has put in a normal amount of your on-the-air time working code QSO's, your code speed probably exceeds 20 wpm now and you'll only be interested in subsequent theory articles. On the other hand, if you're an ardent phone or RTTY operator (or if you've been off the air for a while), you may need a few hints on how you should get your code speed back up to where it was and then on up to 20 wpm.

The best way to increase code speed is still on-the-air QSO's with other code stations. Make room on your operating table for your handkey, bug, or electronic keyer and shove that mike aside.

If you are very rusty, move into the Novice code bands on 80, 40, and 15 meters. Please be very patient with these new hams and remember that a little consideration means a lot to a guy who's just learning the game. Be patient and make sure any criticism you make is of a constructive nature. Leave that final off when you're in the Novice bands to avoid unnecessary interference. As a general rule, you'll find that the slowest Novices seem to congregate on 80, faster ones on 40, and the fastest seem to get on 15; you'd do well to

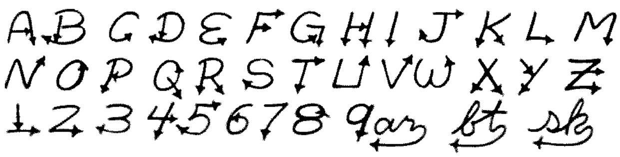
move up through their bands as your code speed picks up. In addition to being courteous, please remember that a QSL means more to a beginning ham than it does to you; make it a practice to ask for their address so you can send a card to each new station you contact.

Once you start to get your code ability back, move out into the 'general' bands and get in as much code operating time as possible. Make it a practice to answer guys who are sending at a rate which will make you 'sweat' a bit and tell them you are looking for a little code practice so there's no need to keep the QSO brief unless they are in a hurry. Whether you are practicing code with on-the-air contacts or by any other method, you've got to set aside a certain amount of time each week for code practice and stick to it without fail; four hours per week should be the minimum amount of time devoted to your code program. You can have a little fun working regular code schedules with other guys who are striving to reach the 20 wpm goal.

One of the best ways to increase your code proficiency on the air is to participate in as many local, national, and international contests as time permits. Field day, sweepstakes, C-D, QRP, DX, and other contests provide excellent operating opportunities. Read your radio publications carefully and mark a calendar (at your operating position) to remind yourself when each contest is on. Remember to submit logs when you participate in a contest to provide validation for the other contestants, whether or not you are interested in your own contest standing.

If you want to kill two birds with one stone, you should handle traffic as part of your code speed program. There are bound to be nets you can join which are on at times, frequencies, and speeds which are suitable. Message handling will develop high-speed transcription habits if you stick in there and handle a lot of traffic.

If you're in a club, get the group interested in conducting an "extra class" course, including a 'high-speed' code class. Your club would do well to plan a 16-week course with a single 3-hour class each week. Each class should consist of a 55-minute code session, a 10-minute coffee break, and a one hour and 55-minute theory class. Club instructors can't assume code ability on the part of their students; they'll have to rely on results noted during the code speed runs which are held as part of the code sessions. An initial code speed ability of 7 wpm should be required of all 'extra class' students and each student is expected to increase his code speed 1 wpm each week of the course to progress to a 22 wpm code proficiency by the end of the course. During the first code sessions, stress the fact that code transcription must be both rapid and legible. Teach a system of fast printing which will provide positive character identification. Table I shows a printing system I've taught for the past decade; I think you will find this variation of prescribed government printing is well-suited to code transcription. If you've ever tried to write a pair of E's in the middle of a high-speed run, I'm sure you realize the advantage of making this



Note:

1. Arrow heads indicate the end of pencil strokes.
2. The first and last numbers (one and zero) are distinguished from the letters I and O.
3. The last letter (Z) is distinguished from the number 2.

Table I. Speed Printing System

letter as I suggest rather than to print each one as many as four separate pencil strokes. Every character must be transcribed as quickly and easily as possible and it must be easily read to be useful; stress good copying habits and have students practice their printing from the start of the slow speed runs so that they'll have the system down pat by the time they get up into the high-speed code.

Next to on-the-air code contacts, pre-recorded magnetic tape recordings provide the best means of building code ability. Pre-recorded code practice tapes permit students to copy error-free, perfectly-timed code runs which provide the maximum amount of useful code copying time because students don't have to wait idly while the code instructor makes a character-by-character count to determine what exact speeds were sent during each part of each run. There are several pre-recorded tapes available but I don't know of any which have the amount of high-speed code practice you'll need to progress past 20 wpm. A set of seven 1200-foot tapes, recorded at 3¾ ips, will do the job perfectly; they'll take students from 7 wpm to 22 wpm. If you use a set of tapes like mine, the student will be required to progress from 7 through 10 wpm before he leaves the first tape. Each side of each succeeding tape requires the student to increase his code speed 1 wpm before he progresses on to the next side/tape in the series. I've used this system very successfully with thousands of students and I know it does the job extremely well. In addition to the advantages already covered, pre-recorded tapes free the code instructor from the code oscillator and permit him to wander about among his students to see how they are progressing and to correct obvious faults. Another major advantage to having a complete set of code practice tapes at your club is that you'll be able to make as many duplicate copies as you want to let your students get as much code practice as they need (at home) between weekly classes. Any club instructor who wants to make up a set of code practice tapes would do well to consider a set

Letter	"Old" ICAO Phonetic	"New" ICAO Phonetic
A	Able	Alfa
B	Baker	Bravo
C	Charlie	Charlie
D	Dog	Delta
E	Easy	Echo
F	Fox	Foxtrot
G	George	Golf
H	How	Hotel
I	Item	India
J	Jig	Juliett
K	King	Kilo
L	Love	Lima
M	Mike	Mike
N	Nan	November
O	Oboe	Oscar
P	Peter	Papa
Q	Queen	Quebec
R	Roger	Romeo
S	Sugar	Sierra
T	Tare	Tango
U	Uncle	Uniform
V	Victor	Victor
W	William	Whiskey
X	X-ray	X-ray
Y	Yoke	Yankee
Z	Zebra	Zulu

Table II. International Civil Aviation Organization Phonetic Alphabets

like the one I've recorded and the following breakdown provides the major information needed to produce a set of 'high-speed' code practice tapes:

a. General—Use only one tone throughout a code run and try to have that tone be from 400 to 1000 cps to suit the majority of your students. Use plain-language and mixed-group (5-letter, alphabet-only) runs very sparingly because cipher groups (letters, numbers, punctuation marks, and work signs sent in 5-unit-count groups) provide the best code practice. Precede each code run with a statement of what will be sent; state the tone, type of key, length of run at each speed, type of text (mixed groups, cipher groups, or plain language), and any other pertinent data. Immediately after each run, provide a complete phonetic read-off of what was sent and identify the speeds used at each point where the rate changed. Use only punctuation marks and work signs (in addition to the alphabet and numerals) which are used in FCC code exams. End each side of each tape with an FCC-type 5-minute plain-language code test at the rate the student must pass before he progresses to the next tape or the second side of the tape he's using. Use 'over-the-hill' runs as much as possible; these start at a low speed, progress past the speed the then drop back down to the speed he should pass before he leaves the side of the tape he's using.

b. Tape Breakdown—The tapes should contain the following code instruction material:

Tape #1, Side #1. Reintroduction to the work signs and punctuation marks used in the FCC code exams (and in the code tapes). Two over-the-hill (O-T-H) cipher group runs @ 7-10-8 wpm. A 5-minute cipher group run @ 8 wpm. A 5-minute plain-language run @ 8 wpm.

Tape #1, Side #2. Cipher group O-T-H runs @ 8-11-10 and 8-12-10 wpm. A 5-minute cipher group run @ 10 wpm. A 5-minute plain-language run @ 10 wpm.

Tape #2, Side #1. Cipher group O-T-H runs @ 10-12-11, 10-13-11, and 10-15-11 wpm. A 5-minute plain-language run @ 11 wpm.

Tape #2, Side #2. Cipher group O-T-H runs @ 11-13-12, 11-14-12, and 11-16-12 wpm. A 5-minute plain-language run @ 12 wpm.

Tape #3, Side #1. Cipher group O-T-H runs @ 12-14-13, 12-15-13, and 12-15-13 wpm. A 5-minute plain-language run @ 13 wpm.

Tape #3, Side #2. 3 cipher group O-T-H runs @1 3-16-14 wpm, plus a 5-minute plain-language run @ 14 wpm.

Tape #4, Side #1. 3 cipher group O-T-H runs @ 14-17-15 wpm, plus a 5-minute plain-language run @ 15 wpm.

Tape #4, Side #2. 3 cipher group O-T-H runs @ 15-18-16 wpm, plus a 5-minute plain-language run @ 16 wpm.

Tape #5, Side #1. 2 cipher group O-T-H runs @ 16-20-17 wpm, a 5-minute cipher group run @ 17 wpm, and a 5-minute plain-language run @ 17 wpm.

Tape #5, Side #2. A cipher group O-T-H run @ 17-23-18 wpm, an 8-minute cipher group run @ 18 wpm, and a 5-minute plain-language run @ 18 wpm.

Tape #6, Side #1. 2 cipher group O-T-H runs @ 18-23-19 wpm and a 5-minute plain-language run @ 19 wpm.

P,TH	N6AV	2LDR	Q5XE	Jbt8	U4IK	Csk1
F/MB	O3?	ar7G	ØY.	SW9Z	2,E	CskOJ
G.LA	6T/	QMarP	4U8	WIRØ	HbtDS	Y91
3B?	V5ZN	X7KF	TØ?	LarVO	I1sk	D3XN
K.FY	GA/R	7MBS	U29	P,6	4Ebt	CQZ8
W5JH	1L,	Far?	ØA/	OWH3	MskJB	9.Z
CR5Q	S7bt	6EXT	D8PI	K4YV	UN2G	(etc.)

Table III. Typical Cipher Groups

Tape #6, Side #2. 2 cipher group O-T-H runs @ 19-24-20 wpm and a 5-minute plain-language run @ 20 wpm.

Tape #7, Side #1. 2 cipher group O-T-H runs @ 21-27-22 wpm and a 5-minute plain-language run @ 21 wpm.

Tape #7, Side #2. 2 cipher group O-T-H runs @ 21-27-22 wpm and a 5-minute plain-language run @ 22 wpm.

Use recognized phonetic codes in making your read-off of code practice runs. Table II shows the old and new ICAO phonetic alphabets which are the two most frequently used sets of phonetics.

Table III shows typical cipher groups such as I use in my own series of code practice tapes; you'll need to make up several hundred different 5-unit-count groups for use in each of your code tapes. Remember that each "word" has a 5-unit count, based on letters having a 1-unit count and each punctuation mark, work sign, and numeral having a 2-unit count. Use each symbol an equal number of times and use a 'chance sequence' selection system to avoid any pattern of combinations.

To summarize the preceding paragraphs, I'm simply reminding you to do something which I'm sure you've known all along; you've got to set your mike aside and start using code. Club members can add a little interest to their code proficiency program by having code competitions between all club members and posting the test results regularly. League-affiliated clubs can make use of ARRL club code proficiency awards, plus their own stickers, to provide some shack wallpaper to show how each member is progressing in his individual battle to get "over-the-hump."

It may be that you have forgotten some of the good sending habits you knew. You'd do well to have your sending checked out by someone who is an expert and listen to his constructive criticism, if he has any to offer. It is quite possible that you may have developed poor sending habits and, if this is so, you should make a determined effort to get rid of them at the start of your code improvement program.

TF1-4539 and TF1-4540 are a pair of Air Force training films which cover, "The Technique of Hand Sending," and, "Rhythm,

Speed, and Accuracy in Hand Sending," respectively. These films are F-24 and F-25 in the ARRL film library and league-affiliated clubs should show them as part of their code program. Non-affiliated clubs can borrow these films through local military outlets.

As far as your code operating arrangement in your station is concerned, you would do well to make certain everything is set up for the best possible results. One of the most common goofs I find is that hams don't mount their handkeys to the surface of their operating table (or anything else, sometimes) or they are mounted incorrectly. Your key should be securely mounted in the position where it is in line with your forearm when you are seated normally at your operating position; you shouldn't have to reach for the key nor should the elbow of your sending arm be off the edge of the table. You must be comfortable and correctly positioned to send code at your best. A second common goof I find is that most stations don't have any code monitoring arrangement. It is best to have a code monitor and it is relatively simple to build and install a good one. The third most common goof I find is that stations are not set up for efficient operation. It is foolish to work with 'hay-wire' setups when you can make an efficient, easy-to-operate station by just expending a little time and intelligent effort. Take the time now to make your station a better code station and this will help you become a better operator much faster.

Many hams leave handkeys too soon. If one shifts to a bug or electronic keyer before he completely develops a good fist with a handkey, he may never finish developing the fine sense of rhythm needed for top code operation. If you've never developed good handkey ability, you should slow yourself down for a while and develop it now; you'll soon be back up to the speed you presently have but you'll be sending much easier and better than ever before.

Licensing class instructors in league-affiliated clubs should make sure they have a copy of the ARRL, "Licensing Classes," brochure which contains a lot of information vital to 'general' licensing classes; most of the material is equally useful in an 'extra' licensing class.

That wraps this one up, gang, and I hope you make it all the way to that extra class ticket as soon as possible; I know 73 is planning a detailed series of articles to help you with the material you must know to pass the written portion of the extra class exam.

. . . WA6VTL

73 Tests the Gonset Six Meter Sidewinder and Linear Amplifier

Everyone who operates VHF knows the Gonset Communicator. It was the rig that brought real life to the six and two meter bands. Not content with stealing the first honors, Gonset has been busy again and brought out another piece of equipment that will make all of the six meter boys drool. It's the Gonset model 910A six meter Sidewinder SSB transistorized transceiver. We reviewed the two meter model a few months back and had been waiting anxiously for the six meter one. It fulfills all of our expectations and then some.

Sideband is growing on six at a pace that the AM boys consider as merciless as the take-over of the HF bands. The SSB contingent is growing larger every day—and fine commercial gear such as the Sidewinder accounts for most of this growth.

The Sidewinder is a real pleasure to use. It covers four one-megacycle ranges from 50-54 mc. Tuning over the megacycle on each range is very easy. There's both slow and fast tuning with a very solid feel in the movement. In addition, there's a convenient receiver offset control that permits you to tune over a 3 kc range centered on your transmit frequency. The receiver provides very low-noise reception and plenty of gain and audio output for mobile use.

Transmitting with the Sidewinder is a real pleasure, too. It's very easy to tune up. One nice feature is four switch-selected crystals so that you can work DX down in the CW part of the band. They're also good for net operation. The Sidewinder has provisions for CW, AM or SSB. It even uses separate AM detector on receive. The receiver has a sensitivity of 0.5 microvolts for 10 db S/N ratio. Image rejection is 50 db. The unit is extremely stable. We couldn't find any noticeable drift. The crystal-lattice filter at 9 mc provides perfect selectivity for SSB.

The transmitter runs 20 watts PEP input to a 6360. On CW the input is 20 watts, on AM about 6. Spurious suppression is down 40 db, unwanted sideband down 40 db and carrier is down 50 db.

The Sidewinder is completely transistorized and solid state except for three tubes used in VHF portions of the transmitter. You can turn their filaments off for standby receive, so that the transceiver draws almost no current from your car battery.

The instruction manual provides complete information—even about alignment. It should be very helpful if you ever need to fix the gear, which is unlikely because of the transistorized design and modern high-reliability components.

We also tried out the Gonset Model 913A six meter rf power amplifier. It's an interesting departure from the extreme miniaturization craze of late. There's no reason to waste a lot of space with transistorized gear, but for an amplifier rated at 500 watts, we sometimes get suspicious of an ultra-tiny construction. The 913A is solid and husky. It uses full-sized underrated components for high reliability and lack of trouble. It runs 500 watts PEP on SSB and also works perfectly on CW, FM and AM. It only requires 5 watts of drive for linear service for full output. The amplifier tube is a 4X150A—though you can use other tubes in that family if you wish.

The complete power supply is included in the 913A. It's all solid-state except for the voltage regulated supply for the 4X150A screen. You aren't likely to have much trouble with it!

So much for a description. You're probably curious about the results. They're outstanding. We got the set going up on the mountain. Everyone we worked commented on the excellent signal. There was no distortion, spurious signals, instability, etc. All of the reports were first class. We've lost count of the stations and states worked, but it has been well-tested in all propagation methods commonly used on six: line-of-sight, extended ground wave, sporatic E skip, and aurora. It's a fine rig; our only complaint is that it has to go back to Gonset before the June contest.

. . . 73

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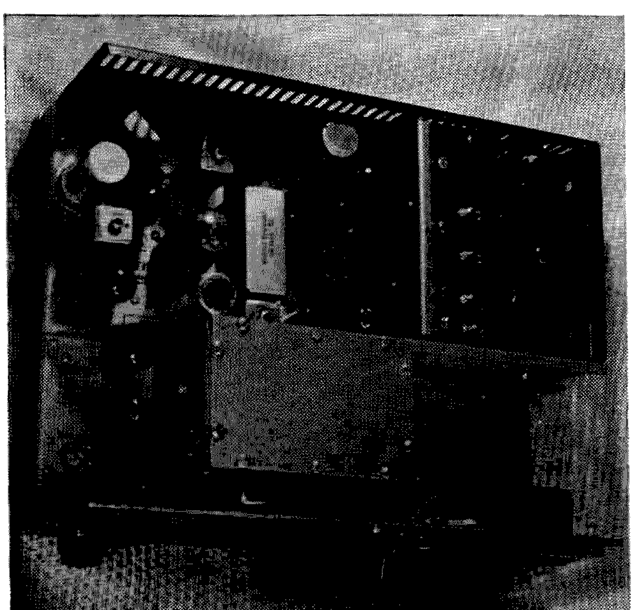
Converting the 20m Swan to 2

With the increase in the production of the production of the many SSB transceivers today, one can find some of the single-band units on dealer's shelves for a small fraction of their true value. This was the foremost factor that prompted me to look into the possibility of using one of these single-banders on VHF.

At first glance this looked as if it would be an impossible job; but now that it has been completed and works so well, we can look upon the transceiver in its two meter form as if it were always this way. The unit has been in use for about three months in the 50 miles between home and work that I travel every night. I can honestly report that if you haven't tried VHF SSB transceiver operation mobile, you haven't completed your amateur career. It's a tremendous pleasure. I've never had as much success with any of my various mobile rigs as I get with this 2 meter version of the Swan and the "J" beam mobile antenna.



Side angle view of the converted Swan SW-120 transceiver ready for action on 144 mc. Two meter section is at the upper left.

In this article you will find out exactly how to convert a 20 meter transceiver so that it will work on a 600 kc section of 2 meters in four steps. In the next issue the final amplifier that mounts in the trunk with the power supply will be described.

To start the project you must acquire a single or tri-band SSB transceiver. This conversion can be made with other transceivers changing just the physical mounting of the converters slightly. The unit I used was the 20 meter Swan SW-120.

If we analyze the operating necessary to convert a 20 meter transceiver to two meters, it will be noted that you have two converters—receiving and transmitting—to bring the original 14 mc frequency to 145 mc. This is the same situation encountered at the station with a separate receiver and transmitter. In the transceiver, however, we have the receiver and transmitter using many of the same components on each side. We must, then, separate the receiver front-end and the transmitter-driver (not the final) and feed them into the converters. This is all that's required.

Converter Construction

By using fiberglass epoxy boards (with clad copper on one side) this project becomes quite simple. These boards can be purchased with all holes punched, sockets mounted and ready for parts from the Melco Co., Marissa, Ill., for $15. A complete kit of parts is also available from this firm.

If you build these units from scratch, proper size has to be noted so that the two boards will fit perfectly in the space that was used originally to house the 6DQ5 14 mc amplifier, which has to be removed before anything can be mounted. Everything but the coax connector is removed from this final cage. The

tube socket for the 6DQ5 is left on the vertical panel that runs through the middle of the Swan. This necessitates removing the wiring harness from this socket and taping the loose ends. Leave all connections as they were originally installed on the V^1 tube socket.

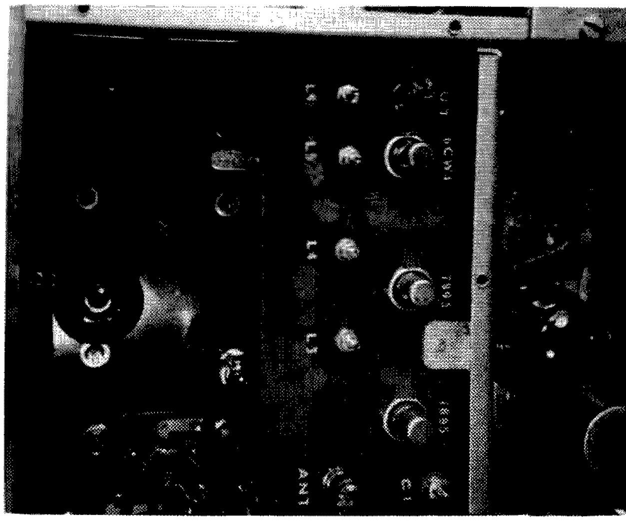
The oscillator-tripler is used for receive and transmit so that transceive facilities will be correct. It is capacitively coupled to the transmitting mixer and inductively coupled to the receiver. This is through L_2. The 6360 PLATE and LOAD controls are mounted on the rear apron of the original chassis, enabling you to tune the two meter final from outside the cabinet. The GRID TUNE is broadband enough so that it will operate over the entire 600 kc segment with no difficulty.

The receiving converter has two 7895 nuvistors in a neutralized cascode circuit which drives the 6CW4 mixer. 6CW4 tubes could be used in place of all three tubes without any modification, but the 7895 will give you a little better performance. (Tests from here show that the 7895 gives I db better signal-to-noise ratio.) Be very careful that shield be placed in between each of the stages. Self-oscillation will be apparent if the shields are not well made. They are constructed from the fiber epoxy boards with copper on *both* sides. Holes are drilled in respective locations for the L_{10} lead, L_8 lead, and all of the 2200 ohm plate resistors and filament leads to be passed through. No feed-thru capacitors are necessary here.

The original filament circuit has to be completely rewired so that it can be used with 12.6 volts. With the 6DQ5 out of service now and the other additions made, the circuit must be rewired. By following the schematic closely and paying attention to the tube numbers in the original Swan manual, this is not too difficult. But it has to be done and now is the best time in the conversion to do it.

Connecting Converters to Transceiver

After the converters are completed, be sure and check for proper resonance of all coils and a final check that wiring is correct. With this done and everything found to be in order, the ventilation holes that were originally under the 6DQ5 are cut out so as to accommodate the transmitting board. The receiver board is mounted on the side of the final stage (which had the feed-thru) to connect the original 14 mc rf amplifier to the tank circuit). Remove this small feed-thru and place the receiver board up as close to the top lip of this panel as possible, making sure that the nuvistors and the coil slugs do not extend above the top



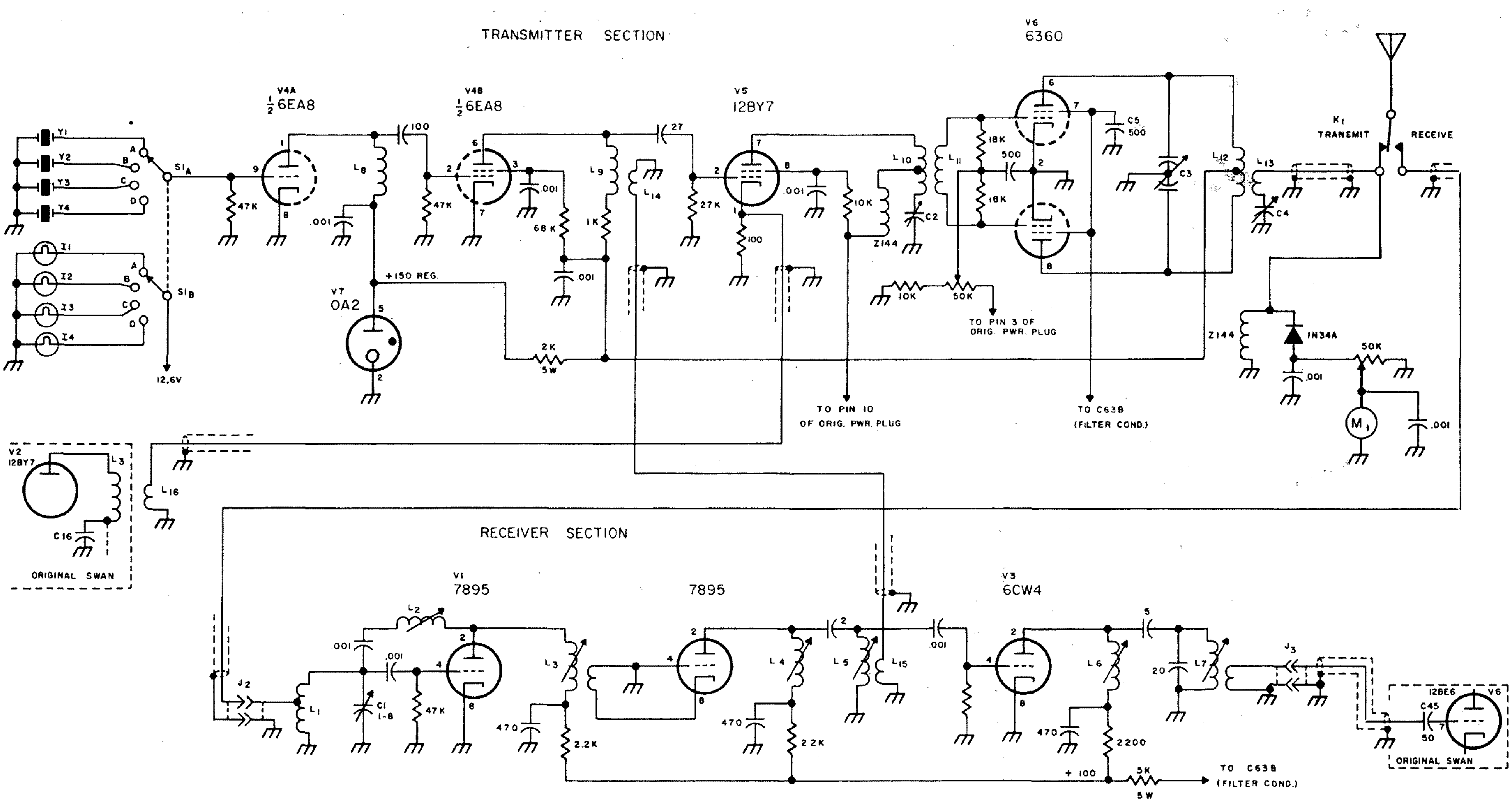
Close-up view of the installed epoxy board converters in the transceiver. Nuvistorized assembly at the left is the receiving converter, while the transmitting converter is at the far right.

so that the cover can be replaced without trouble. Mount the receiver board by using a small right angle piece of aluminum bolted onto the top of the board and fastened to the cage after the board is set into the correct location.

A small piece of RG-174/U 52 ohm cable is run from pin 1 of the transmitting converter's 12BY7 through the main chassis to a two turn link (L_3) which is placed around the original driver coil (L_2) that was connected to the 6DQ5 via a .002 mf capacitor. This capacitor can be taken out. The 14 mc signal is now routed through the small coaxial cable to the two meter transmitting mixer and completes the wiring of this board.

The receiver converter is connected via the coaxial cable connected to the link around L_6 of the receiving converter to C_{45} in the original grid circuit of V_6. This cable is plugged into the output of the converter. The osc.-tripler is coupled to the 6CW4 receiver mixer via another small piece of RG-174U. One end is connected to the link on L_8 and the other end to the link on L_2. The input of the receiving converter and the output of the transmitting converter is connected to a Motorola antenna relay that mounts on the back panel beside the coax connector which is connected to the antenna side of the relay. The coil of this antenna relay is parallel to the original push-to-talk relay of the Swan. This enables the antenna relay to switch the converters as the PTT sitch is keyed.

The final step is to connect the B-plus voltages. These are available through various dropping resistors located in the Swan. By



C_1—1-8 mmfd miniature tubulor trimmer.
C_2—3-25 mmfd miniature single section variable.
C_3—3-15 mmfd minioture butterfly.
C_4—3-35 mmfd single section miniature voriable.
K_1—Original Swon relay.
K_2—12 v. relay from Motorola VHF equip.
L_1—10t. #24 e. closewound on ½″ ceramic form.
L_2—4t. #20 tinned on ¼″ ceramic form, wound length of form with 2t. link of #22 plastic hook-up wire on hot end.
L_3—2t. link of #22 plastic covered hookup wire.
L_4, $_5$—5t. #20 tinned ⅝″ dia. ¼″ spacing, 1¼″ long.
L_6—30t. #30 e. closewound on ¼″ dio. slug-tuned form.
L_7—Same as L_6 with 2t. link around center.
L_8—4t. #20 tinned on ¼″ slug-tune form, wound length of form wth 2t. #20 plastic hookup wire link.
L_9—Same os L_8, without link.
L_{10}—Same as L_8.
L_{11}—12t. #30 e. closewound on ¼″ dia. slug-tuned form.
L_{12}—5t. #16 tinned ¼″ dia. ¾″ long, topped at 2t.
M_1—Triplett 220-M, 0-1 ma. meter.
X_1—43.60 mc type FA5 third overtone crystal.
X_2—43.65 mc type FA5 third overtone crystal.
X_3—43.70 mc type FA5 third overtone crystal.
X_4—43.75 mc type FA5 third overtone crystal.

using a VTVM with the sideband transceiver on, a check can be made at various points at the filter capacitors. The voltage for the 6360 plate is acquired through a bleeder resistor in the final so that the high voltage is not taken from the 300 volt side of the power supply to function properly. Note that the 6360 plate is connected to the pin that was used in the original plug, the 6DQ5.

Testing the Units

With all proper voltages found and applied to the units, the testing commences. The oscillators should be operating and feeding the tripler so that the 130 mc signal is fed to the receiver and transmitter converter. With this functioning, the receiver should be capable of receiving signals if the coils are on the proper frequency. By using a noise generator (one is available from Melco Co., Marissa, Ill.), proper alignment of the receiver can be achieved.

With the receiver operating, the transmitter should be tuned up. Insert some carrier or a 1 kc tone and note the output on the dummy load. Make sure that L_4 does *not* tune 130 mc, but rather 145!

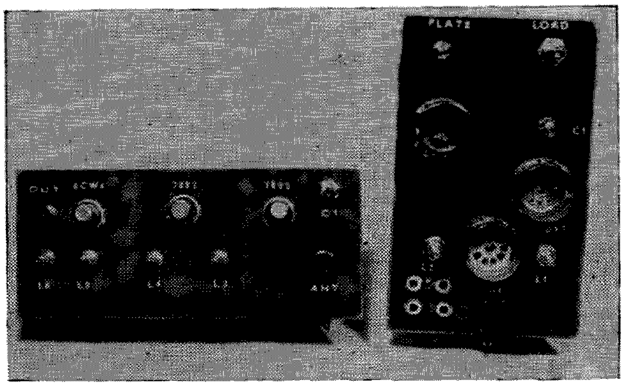
Output Meter

The original meter was used to measure the plate current of the 6DQ5 final amplifier. This is not necessary here so long as you can tell maximum output, so the meter was changed to a 0-1 ma. This is used as a relative rf meter and is hooked up with the 1N34A diode to read the output of the transmitter. The 50K pot. was mounted on the front panel where the PLATE TUNE was originally located. This gives you a METER ADJUST so it can be made very sensitive, enabling a carrier null condition. Make sure you don't talk into the microphone with the meter wide open, since the meter will be banged against the pin and meter movement will be damaged. By using care, this rf meter can become a very useful aid in tuning this transceiver on 2 meters.

Voltages

The BIAS-ADJUST pot for the 6360 is mounted on the rear apron near the power plug. The bias should be adjusted so that the 6360 receives 22 volts. This can be set once and forgotten.

The proper voltages for the transmitting converter section should read as follows (all measured in the RECEIVE position): 6EA8 triode plate—150 vdc reg.; 6EA8 pentode plate—280 vdc; 12BY7 plate—300 vdc, screen—160 vdc; 6360 grid—minus 22 vdc, screen—200 vdc, plate—300 vdc. The receiving converter should receive 60 vdc on the plates of all nuvistors.



Converter (left) and transmitter boards.

Bandswitch Lights

Four lights are mounted on the front panel below the meter making it very easy to connect them to S_1. These lights are the aluminum sleeve-type and can be purchased from Melco Co., Marissa, Ill., for $1.50 each. They are very small in size and are different colors which correspond to the different number colors printed on the new dial. This makes it very simple to see what frequency the transceiver is on at all times. As the BANDSWITCH (mounted in the original TUNE SWITCH position) is turned, the lights will change to the correct color of the proper band. The TUNE-OPERATE switch is moved to the spot directly under the meter and is still wired as was originally installed. The BANDSWITCH is then mounted at the bottom of the 6EA8 socket underneath the chassis and the shaft is extended through the original hole used to mount the TUNE switch.

The New Dial

The new dial can be calibrated using the same markings as the original by painting over the 14 mc markings with white paint and replacing with four colors to match with the bandswitch lights. This allows the 2 kc markings on the original dial to be used.

With all this completed, the low frequency transceiver has been successfully converted to two meters. All operating facilities have remained the same including the push-to-talk, carrier balance, tune up and transceive. With the Swan you use practically every section. The main thing to remember is that when you tune the receiver, the transmitter goes right along with it. After you get accustomed to the idea, you'll never go back to ancient modulation.

I hope that this article is of some value to those who want to take on this project. Get to work and get those two meter SSB transceivers on the air!

. . . K9EID

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How's Your VHF Beam Working?

Have you ever wondered if the specifications that the manufacturer gives for your beam are correct? If your antenna is radiating as effectively as you hope that it would? If your radiation pattern is what it should be? If you have asked yourself these questions, and are looking for a good way of answering these questions, read on.

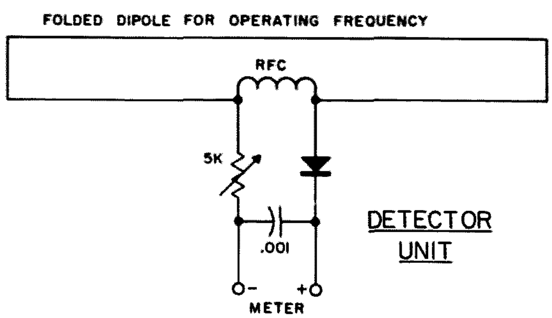


Fig. 1. Detector dipole.

Probably the best way of measuring the gain of a beam is by the comparison of the beam with a reference dipole. The gain figures for beams are usually given as the gain over a dipole, so why not measure it that way? To do so requires an antenna handbook, a coaxial relay, some coax, a VTVM or sensitive microammeter, a pot, a diode, some twinlead, a capacitor, and a little work.

The measurement dipole is placed a distance away from the main antenna. The dipole is terminated with a detector that will allow field strength readings to be made on a meter or VTVM. The details for the detector are shown in Fig. 1. The dipole is cut for the operating frequency as determined from the antenna handbook. Regular 300 ohm TV type twinlead will work fine. The ends are soldered together to form a closed loop and one conductor is broken in the center for the rf choke. The components can be left hanging or mounted in a small Minibox, according to your preference. The completed unit should be mounted in the clear, and at least 30 or 40 feet away from the main antenna, if possible.

The next thing to do is to make a reference dipole. A doublet cut to the proper frequency and mounted on a broomstick or other support will do. If a broomstick or wooden support is used, it should be covered with Q dope to prevent moisture from causing a loss. The coax relay is used to switch the transmission line from the reference dipole to the main beam. It should be mounted right next to the reference dipole. The coax from the transmitter is disconnected from the beam and connected to the relay. The length of coax from the relay to the beam should be an exact electrical wavelength, or multiple of an exact wavelength, long. This is to keep the phase of the two signals the same as much as possible.

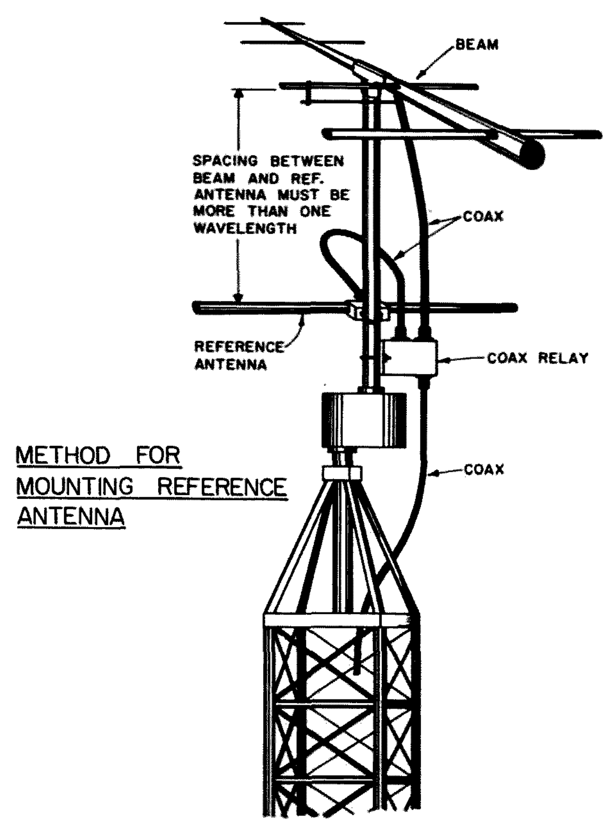


Fig. 2. Mounting reference antenna.

The reference antenna should be mounted on the same mast as the beam, and facing in the same direction. It should be mounted at least 2/3 of a wavelength away from the beam to prevent interaction. A wavelength or more would be desirable. The reference antenna can be left up permanently, if desired. Be sure to remember to allow for the difference between the physical and electrical lengths of a wavelength when cutting coax (velocity factor).

After everything is set up, the next step is he actual measurement. It is helpful to have SWR bridge. The first thing to do is to load the transmitter to a low power input. Connect the SWR bridge and note the forard and reflected readings. Now go out and measure the level of the signal. Connect the eam, set the forward power to the same level that the reference dipole had, note the WR and go out and measure the level of the signal. After this is all done, you can calculate the forward gain of the beam. Refer to **Fig. 3.** Assuming that the reference level of the dipole is one (this can be an arbitrary unit, as long as all other readings are relative) you can find the gain by looking up the relative signal level. If there is any difference in the SWR of the two antennas be sure to include this in your calculations. This is done by finding how much more power is being radiated by the antenna of the lowest SWR and changing power ratios to compensate. SWR to power tables should be in any antenna handbook. or finding the front to back ratio, set the level of the back of the beam to one and

Level of Beam (Voltage)	Gain in db
1	0
1.41	3
2	6
2.51	8
2.82	9
3.16	10
3.54	11
3.96	12
4.44	13
4.97	14
5.62	15
6.29	16
7.05	17
10.0	20
17.8	25
100.0	30

$$db = 20 \times \log_{10} \frac{V_1}{V_2}$$

Fig. 3. Level of reference antenna = 1

note the gain of the dipole. Now add the forward gain of the beam. This should be the f/b ratio. The radiation pattern can be plotted by noting the relative levels as the beam is rotated.

The above measurements should give you a fairly good idea of what the beam is doing. By leaving the reference dipole up permanently, you can check your receiving gain on your S meter. You can also run comparison experiments to see if it is possible to work a given station with a dipole, or to see if he can be worked with less power.

I hope that this article has been of some assistance to those that really want to know what their antenna is doing. You may be dismayed or pleasantly surprised. I hope that it is the latter. . . . WA2INM/1

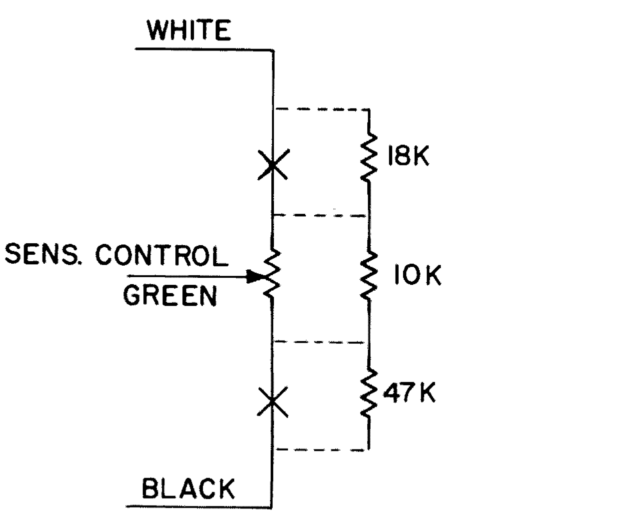
Transformer Noise

All of us at some time have experienced the familiar "transformer hum" which comes quite often from high power transformers. This transformer noise may even be the cause for undue alarm to the novice in radio. Although generally known as a normal occurrence, how many of us actually know what causes the noise?

We all know that the transformer consists basically of coils of wire through which alternating current flows when in use. The alternating current goes first in one direction and then in the other, following a sine or cosine function of time. Since the current in adjacent turns of the coil is in the same direction, an attractive force between the turns of wire is created. This force varies as the current goes through the function of time, reaching a maximum when the current is maximum, reaching a zero value when the current is zero. When the current is large, this periodic force may be enough to cause the wires of the coil to vibrate and produce an audible hum. This hum will vary in pitch depending upon the frequency of the alternating current passing through the transformer. . . . W2QCI

Improving the Tunnel Dipper

Some time ago a Heath tunnel dipper was added to the test gear in the shack. It performed quite well; outstandingly, in fact, in all respects but one. The proper adjustment of the sensitivity control required considerable practice and patience. It was extremely touchy and a nuisance at best.



X'S SHOW BROKEN CONNECTIONS, DOTTED LINES SHOW LEADS TO ADDED PARTS.

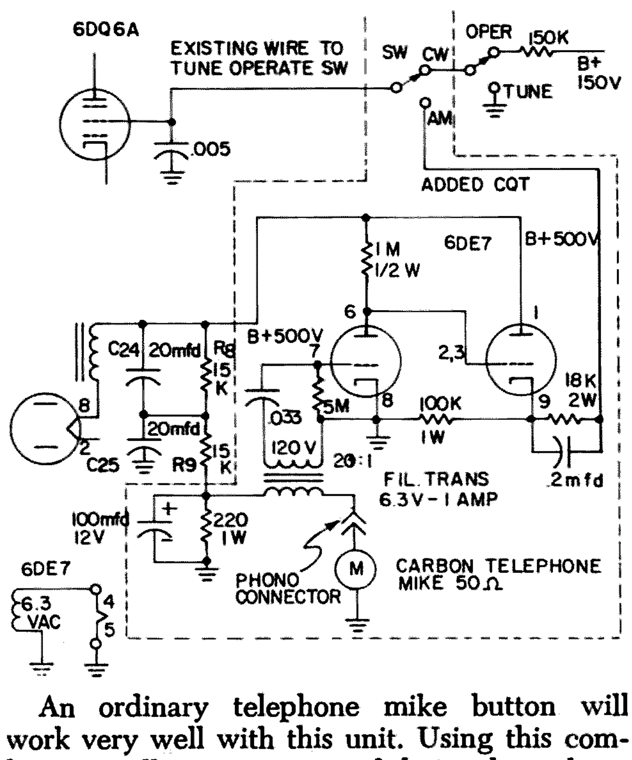
Fig. 1. Modifications to Tunnel Dipper

A cheap and dirty solution to the problem was devised by restricting the range of the pot by the addition of 3 series and shunting resistors. Fig. 1 shows the schematic in detail.

Heath engineers advised that the pot used in the dipper was necessary to insure operation over the wide temperature range specified for the unit. Possibly this was also to accommodate for variations in transistors used in the amplifier. In any event, the above modification seems to have incurred no ill effects, has increased the ease of adjustment considerably, and seems a likely solution for anyone who has encountered similar difficulties. . . . K6MIO

A Modulator for the HX-II

Adding a low cost modulator to this CW transmitter is quite easy and will result in a more versatile piece of equipment. First, drill a hole between the filter choke and the front panel for a miniature 9 pin tube socket. Then add a spdt switch on the front panel above the OFF/ON switch in line with the oscillator tuning capacitor. Next, remove the grounded end of R9, the 15K bleeder resistor, from ground and tie to an insulated terminal board. From this point connect a 220 ohm 1 watt resistor to ground. In parallel with this resitor add a 100 mfd 12 v electrolytic. Wire the rest of the circuit as shown in the diagram.



An ordinary telephone mike button will work very well with this unit. Using this combination all reports on modulation have been very good. . . . WA6PHR

More on Coax Losses

Recent articles[1,2] set forth attenuation figures vs. VHF frequencies of some of the favorite coax cables currently in use. It also shows the maximum length of a coax run to stay inside of a fixed loss of between one and five decibels.

This new tabulation is presented to add the Polyfoam® Coax cables, and to represent the cable by RG and part number. Polyfoam cable was designed to fill a particular need; to lower the capacity of the cable (from center conductor to shield), and to provide a better velocity of propagation (V.P.) for rf energy down the cable. In the table it can be seen that in some polyfoam, a by-product is lower attenuation at the VHF frequencies. However, the equivalent of RG59/U has been changed physically (the diameter is smaller) to maintain a 70 ohm impedance, and subsequently has not resulted in lower attenuation at VHF as in the RG8/U and RG11/U equivalents. At this time there isn't a polyfoam equivalent to RG58/U.

CABLE	AMPHENOL part number	IMPEDANCE	FREQ MC.	LOSS db/100'	LOSS IN FEET 1 db	2 db	3 db	4 db	5 db
RG8A/U	21-290	52.5	50	1.33	75	150	225	300	375
			144	2.42	41.5	83	124.5	166	207.5
			220	3.13	32	64	96	128	160
			432	4.7	21	42	63	84	105
RG11A/U	21-296	75	50	1.51	63	126	189	252	315
			144	2.62	38	76	114	152	190
			220	3.35	30	60	90	120	150
			432	4.8	21	42	63	84	105
RG58/U	21-024	53.5	50	3.13	32	64	96	128	160
			144	5.8	17	34	51	68	85
			220	7.2	14	28	42	56	70
			432	10.08	9	18	27	36	45
G58C/U	21-316	50	50	3.3	30	60	90	120	150
			144	6.0	16.5	33	49.5	66	82.5
			220	7.75	13	26	39	52	65
			432	13.0	7.5	15	22.5	30	37.5
G59/U	21-025	73	50	2.4	41.5	83	124.5	166	207.5
			144	4.0	25	50	75	100	125
			220	4.95	20	40	60	80	100
			432	7.2	14	28	42	56	70
G59B/U	21-794	75	50	2.4	42	84	126	168	210
			144	4.2	24	48	72	96	120
			220	5.3	19	38	57	76	95
			432	7.8	13	26	39	52	65
POLYFOAM RG8	621-111	50	50	1.25	80	160	240	320	400
			144	2.32	43	86	129	172	215
			220	2.95	33.5	67	100.5	134	167.5
			432	4.5	22	44	66	88	110
POLYFOAM RG11	621-100	75	50	.99	100	200	300	400	500
			144	1.78	56	112	168	224	280
			220	2.27	44	88	132	176	220
			432	3.25	31	62	93	124	155
POLYFOAM RG59	624-715	72	50	2.35	42.5	85	127.5	170	212.5
			144	4.3	23	46	69	92	115
			220	5.5	18	36	54	72	90
			432	8.1	12.5	25	37.5	50	62.5

Note that the attenuation in RG11/U is higher than in RG8/U. This happens since the center conductor of the cable is larger to change the impedance from 52 to 75 ohms, but the O.D. remains constant at .405 inches.

Thanks are given to Joe Buckley W6JPO of FXR, Div. of Amphenol-Borg Electronics for his help.

References

1 K5JKX, "Coax Cable Losses," 73, August 1963.
2 Roberts, "Economy?", 73, May 1961.

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. . . W6ORS

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The Design of VHF Tank Circuits

For years, VHF enthusiasts have been hampered by the lack of simple usable techniques for the design of VHF tank circuits. The purpose of this article is to provide simple methods for designing resonant VHF tank circuits of four commonly used types, (1) parallel lines, (2) coaxial lines, (3) trough lines, and (4) strip lines.

First of all, you do not have to be a mathematician; just use common sense and follow the steps indicated. The design information is based on circuits with distributed constants; that is, transmission lines and not lumped constant circuits such as coil and capacitor combinations.

The first difficulty to overcome is the preconceived notion that the entire process is so difficult that it is easier to do the job by the cut and try method—and hope for the best. This is just not so. How often have you had just so much space available for a VHF tank circuit and could not find some workable way to use the tank circuit you had in mind. It is much easier to decide what you want and design it to fit the space you have the first time, knowing beforehand it will tune and that any modifications required will be relatively minor.

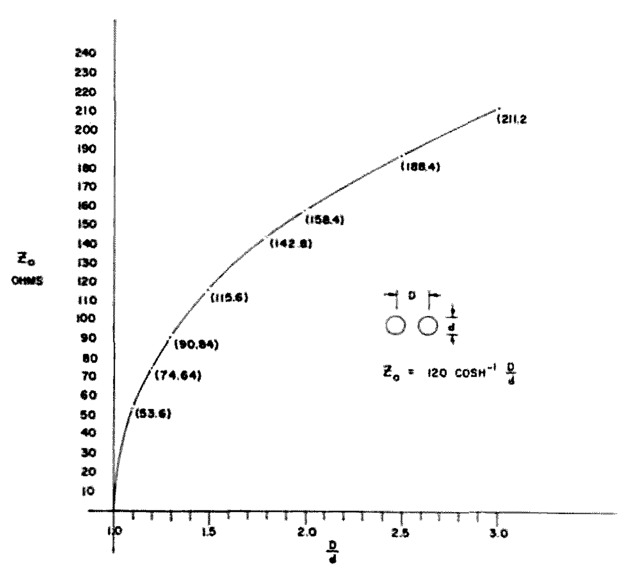


Fig. 1. Impedance of parallel lines.

Calculation of Line Impedance

Since the four types of lines we are dealing with are of the distributed type, the first thing you have to know is the characteristic impedance of the line. Next, you want to know what length of line will be resonant in the circuit you are going to use. Also you would like to know what is the best line length to use, and whether or not you are better off using a quarter wave, half wave, or some other multiple configuration. The data provided here will give you some guidelines on how to make these decisions and what tradeoffs can be made. Some of the formulations are a bit difficult but do not let that scare you. For the most part, they have been reduced to simple graphs and detailed examples are given explaining the design techniques. Most important of all, the graphs give you a visual picture of what happens electrically when the parameters are varied. This provides you with a very useful tool to help make the design decisions required.

Parallel Lines in Air

The characteristic impedance (Z_o) of this type of line is given by the formula

$$Z_o = 120 \operatorname{Cosh}^{-1} \frac{D}{d} \qquad (1)$$

where capital D is the center-to-center spacing between the two lines and small d is the diameter of the line. This assumes that both of the lines are equal in diameter. If they are not, it will not work. Fig. 1 is a plot of Z_o versus the ratio of D/d. This formula applies to lines in air only, but reasonable results will be obtained if the box they are put in is at least larger in each dimension of width and height by a factor of two times the outside spacing dimension of the lines.

Coaxial Lines

The characteristic impedance, (Z_o), of this type of line is given by the formula

$$Z_o = \frac{138}{\sqrt{\epsilon}} \log_{10} \frac{D}{d} \qquad (2)$$

where D is the inside diameter of the outer coaxial member and d is the outside diameter of the inner coaxial member and ϵ is the dielectric constant of the medium between the members, air = 1.0. Fig. 2 is a plot of Z_0 versus the ratio D/d.

Trough Lines

This is a much more difficult configuration for impedance (Z_0) calculation since there is a limitation that the center conductor must be much smaller in dimension than either its centerline height from the base of the trough or the width of the trough. This does not make the formula unusable and the results are acceptable within the limits of accuracy that hams require. Remember that we are considering an open trough only; ends closed but one side missing.

$$Z_0 = \frac{138}{\sqrt{\epsilon}} \log_{10} \left[\frac{4\,\mathrm{w} \tanh \frac{\pi \mathrm{h}}{\mathrm{w}}}{\pi \mathrm{d}} \right] \qquad (3)$$

Where we is the width of the open trough, h is the centerline height of the center conductor from the bottom of the open trough, d is the diameter of the center conductor, and ϵ is the dielectric constant of the material filling the trough. Fig. 3 is a plot of Z_0 versus the ratio of $\frac{w}{d}$ This plot shows ratios of $\frac{h}{w}$ at 0.33, 0.5, and 0.66. Mechanical configurations that vary greatly from ratios shown will have to be calculated directly from formula (3) above.

Strip Lines

The formula for determining the impedance (Z_0) of a strip conductor between two ground planes is also difficult, primarily because of the inter-related geometry of the physical structure. Since this configuration is one of the easiest lines to build, from a mechanical point of view, Figs. 7, 8 and 9 were drawn to provide the essential design information. Data on the line Z_0 is given for 1/16 inch, ⅛ and ¼ inch thick line material from ½ inch to 4 inches wide between ground planes from 1 to 5 inches apart only. These dimensions represent those that are most likely to be used. Other desired values within this range can be interpolated directly with reasonable results. Note that the physical configuration shown in the figures assumes infinite ground planes spaced equally from the center conductor. In practical applications this will not be the case. However, the values given are reasonable,

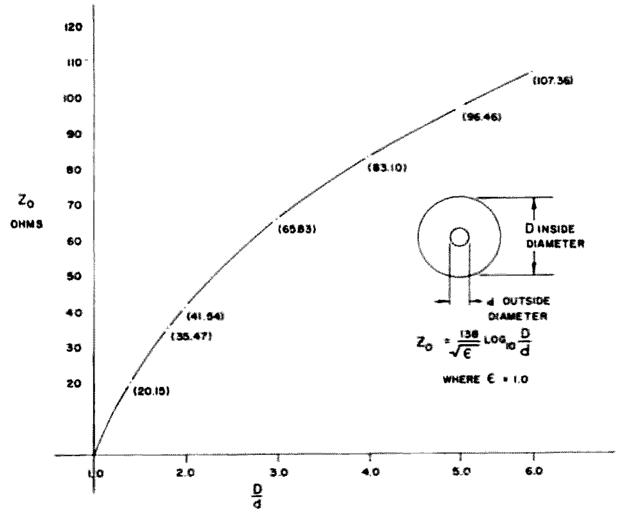


Fig. 2. Impedance of coaxial lines.

provided the ground plane width is greater than the width of the strip line center conductor by at least a factor of two. The only other constraint is that the dielectric medium in which the line is to be operated must be air. If other materials are to be used, the value of the line impedance must be corrected by multiplying the value obtained from the graph by the square root of the dielectric constant of the material used. This, of course, assumes that the entire volume between the ground planes surrounding the center conductor is filled with the dielectric material.

Calculation of Quarter Wave Lengths

The applicable formula for the determination of quarter wave lines is derived from a general equation from transmission line theory and is simply stated as

$$X_c = Z_0 \tan \beta l \qquad (4)$$

where X_c is the capacitive reactance shunted across the open end of the quarter wave line, Z_0 is the characteristic impedance of the line, β is the number of electrical degrees per unit length at the frequency considered (i.e., 360° divided by the free space wave length in the same units as (l)), and l is the length of the line. This may look somewhat formidable but when you look at it closely, you will see that you can easily determine all the elements necessary to find the one you are most interested in, l, the length of the line. To make things easier, Fig. 4 is a plot of X_c versus capacitance for 144 mc, 222 mc, 432 mc, and 1296 mc. It is obvious from this plot

TABLE 1

Freq.	λ in.	$\lambda/2$ in.	$\lambda/4$ in.	$\beta°$/in.
144	82.02	41.01	20.5	4.39
220	53.7	26.85	13.45	6.70
432	27.34	13.67	6.93	13.17
1296	9.11	4.56	2.28	39.52

where λ is the free space wave length.

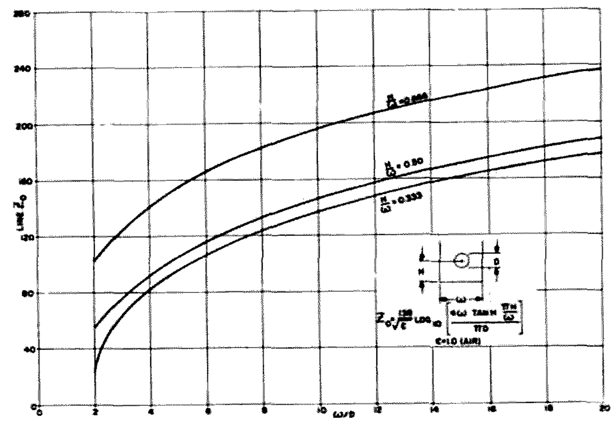


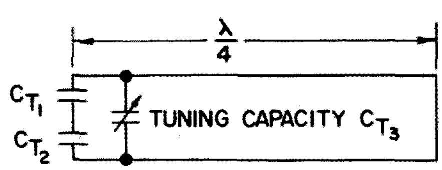
Fig. 3. Impedance of trough lines.

and looking at Equation (4) that at the higher frequencies much less loading capacitance can be tolerated than at the lower frequencies since, for a given capacity, X_c increases with frequency, and I decreases.

At this point the best method of demonstrating use of the design data is to do so by direct example.

Example 1—Parallel Lines

Parallel lines in air are relatively simple to calculate but one factor must be carefully accounted for to make sure that you wind up with the right result. In most cases, the lines are used in push-pull circuit; therefore, the tube capacity loading on the lines is effectively in series. See Fig. 3a.



WHERE $\frac{\lambda}{4}$ = ONE QUARTER WAVE LENGTH

Fig. 3a

Consequently, the total capacity (C_T) equals

$$C_T = \frac{C_{T_1} \times C_{T_2}}{C_{T_1} + C_{T_2}} + C_{T_3} \qquad (5)$$

When $C_{T_1} = C_{T_2}$, the total capacity (C_T) equals the value of one of the capacities divided by two plus the tuning capacity.

$$C_T = \frac{C_{T_1} \text{ or } C_{T_2}}{2} + C_{T_3} \qquad (6)$$

If a tuning capacitor of the double stator type is used, both sections are effectively in series and the total capacity can be calculated using Formula (6).

Parallel lines may be used in single ended configurations provided you add an adjustable capacitor to the side of the line not connected to the tube and adjust this capacitor to equal the same value as the tube capacity. This is not as difficult as it may first appear. All you need is a simple rf probe attached to a sensitive amplifier, such as a VTVM. Apply grid drive to the stage, and adjust the compensating capacitor for identical readings at a spot the same distance from the short circuit end of each line. This will not give you an exact adjustment but it will be close enough.

As a practical case, let's assume the following:

(1) We have on hand lengths of 1 inch OD tubing.

(2) We want to design a $\lambda/4$ resonant tank for 222 mc.

(3) The maximum spacing available is 2½ inches center-to-center to provide good clearance to the sides and bottom of the shielded enclosure.

(4) The line length should be 6 inches or less to fit the space available.

(5) The configuration will be a single ended plate/line using a 4X150A tube.

(6) If these are practical limits, what tuning capacitance will be required for resonance?

Step 1—Determine the line impedance Z_0, by first finding D/d. In this case $2.5/1 = 2.5$, refer to Fig. I and determine the Z_0 for this ratio. In this case, it is 188 ohms.

Step 2—Determine the total X_c and then

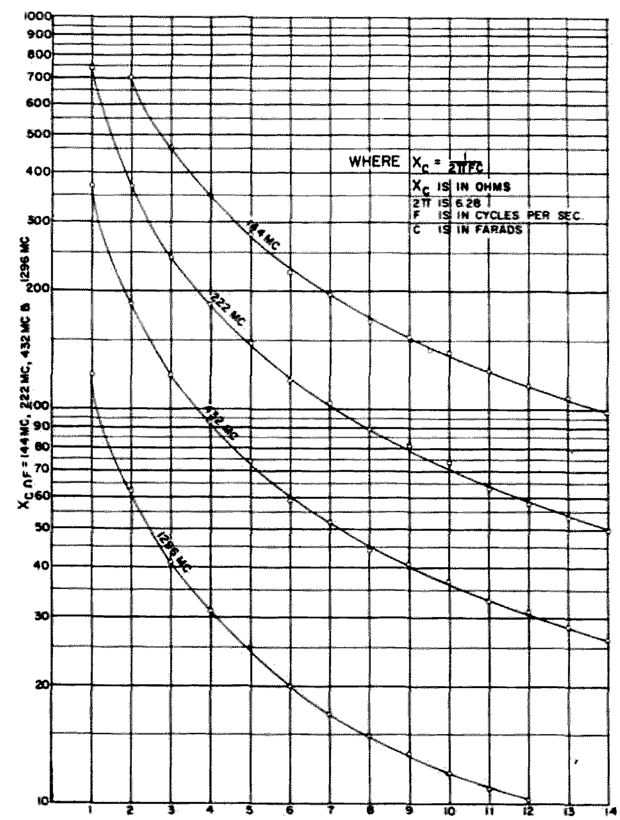


Fig. 4. Capacitive reactance vs capacitance on amateur VHF and UHF bands.

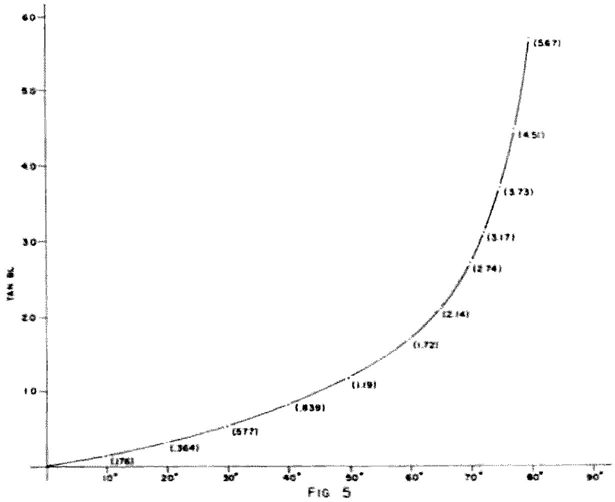


Fig. 5. Tan βl vs angle (tangents of angles).

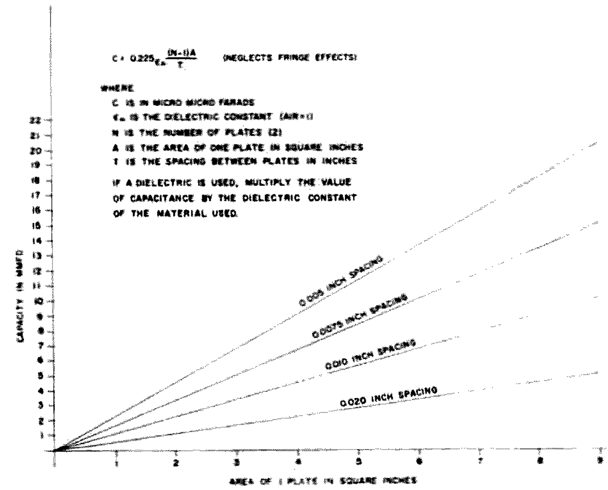


Fig. 6. Capacitance of parallel discs.

the actual capacity required for this length of line to be resonant at 222 mc. from Formula (4).

$X_c = 188 \tan \beta l$

$\beta = 6.70$ from Table 1

$l = 6$ inches (given maximum length from above)

Therefore,

$X_c = 188 \tan (6.7 \times 6)$

$X_c = 188 \tan 40.2°$

Refer to Fig. 5, the tan of 40.2° is 0.85

$X_c = 188 \times 0.85$

$X_c = 159.8$ ohms

The capacity required for this X_c is obtained by referring to Fig. 4 on the 222 mc curve and is 4.6 mmfd. Therefore, the total capacity required to resonate the line is 4.6 mmfd.

Step 3—The output capacity of a 4×150A is 4.5 mmfd and in this case, we will add a compensating capacitor to the other side of the line equivalent to the tube capacity to balance the line. With the compensating capacitor both capacitors are effectively in series; therefore, the tube loading capacity across the line is 4.5/2 or 2.25 mmfd.

Step 4—The additional capacity required to tune the line to resonance is the difference between the effective capacity of the tubes and the total required to tune the line to resonance. For this case, 4.6 mmfd minus 2.25 mmfd equals 2.35 mmfd.

Step 5—If you want to use a disc capacitor to tune the line, refer to Fig. 6 and determine the area of the capacitor plate that yields 2.35 mmfd. Assuming 0.020 spacing to be on the safe side, this yields an area of 4.2 square inches or a minimum diameter of about 1.1 inch. Therefore, the tuning capacitor should be made up of two discs 1.1 inch in diameter or preferably a little larger to give you a better safety factor.

Example 2—Coaxial Lines

We are going to design a coaxial quarter wave plate tank for a 4×150A to be used at two meters.

(A) What would be the length of the cavity be if we used a Z_o of 77 ohms? What is the diameter of the coaxial members for this Z_o?

(B) We have 12 inches of space available for the cavity length; what should be the diameters of the coaxial members?

Condition A

Step 1—Going to the handbook, you find that the output capacity of a 4×150A is 4.5 mmfd. In all practical applications, an amount of capacitance is added at this point for tuning purposes, and effects due to discontinuities in the line, stray capacitance and variation in the tube parameters. Since most of these lines are tuned using circular or rectangular parallel plate capacitors, with one plate soldered on the line and the other movable, Fig. 6 was drawn showing a plot of capacity in micro-micro farads versus the area of one plate. If it is drawn assuming that maximum capacity is used, since it is easier to subtract capacity than add it once the size has been determined. Various spacing factors between the plates are plotted for use, depending on the voltage requirements. A good rule of thumb for determining spacing with an air dielectric is 22 volts per .001 inch. If teflon is used, 600 volts per .001 inch is a good figure. From this data and the information you will determine regarding the diameters of the line, you can readily determine how big a capacitor plate you can fit in the space available. For this example, we will add approximately 4 mmfd, bringing the total capacity to 8.5 mmfd. Referring to Fig. 4, we see that at 144 mc this represents an X_c of 147 ohms.

Step 2—For a Zo = 77 ohms, determine the value of the tan βl.

$$X_c = Z_0 \tan \beta l$$

$$\tan \beta l = \frac{X_c}{Z_0} = \frac{147}{77}$$

$$\tan \beta l = 1.91$$

Step 3—Refer to Fig. 5 and determine what angle the tan βl is equal to, for a value of 1.91. In this case, it is about 62.5°. Now we can determine the element we are really interested in—the required length, l.

Step 4—Go to Table 1 and obtain the value for β. In this case, it is 4.39 degrees/inch. We determined in Step (3) that the product of βl is equal to 62.5°, so by simple substitution we can find l.

$$\beta l = 62.5°$$

$$\text{therefore: } l = \frac{62.5°}{\beta}$$

$$l = \frac{62.5°}{4.39 \text{ degrees/inch}}$$

$$l = 14.24 \text{ inches}$$

Note that the units are consistent.

Step 5—Assuming a 0.005 inch spacing for the capacitor required. Refer to Fig. 6 and for 5 mmfd. A plate area of 1.85 square inches will be required.

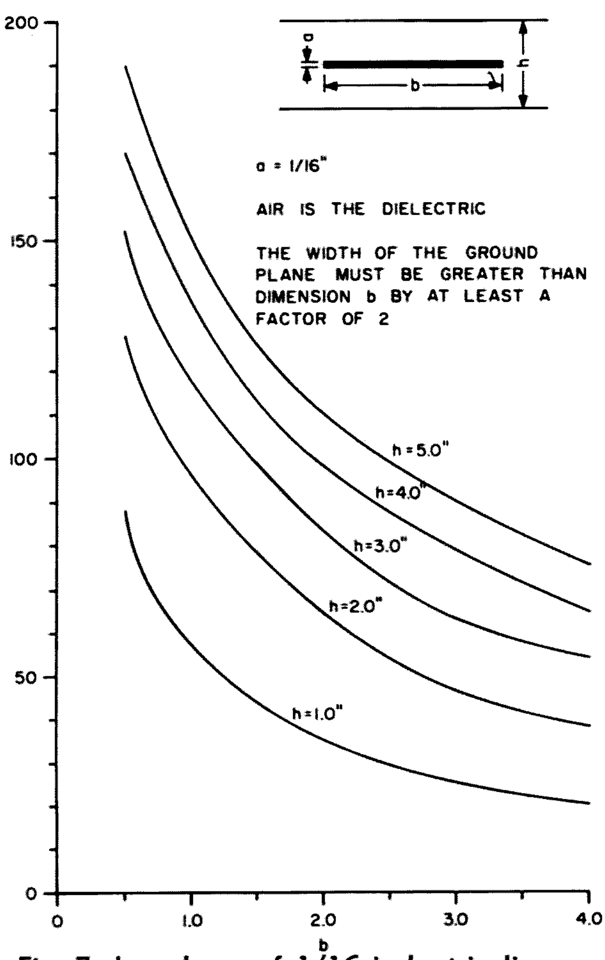


Fig. 7. Impedance of 1/16 inch strip lines.

Step 6—For a Z_0 of 77 ohms the ratio of diameters can be determined from Fig. 2 and is 3.66. This means that if the inner conductor is one inch in diameter, the outer conductor must be 3.66 times one inch or 3.66 inches.

We have now satisfied Condition A.

Condition B

In this case, since the limitation is a given length (12 inches), work backwards and determine the Z_0 of the line required. Then find the ratio of diameters that satisfy the required Z_0.

Step 1—

$$l = 12 \text{ inches (given)}$$

$$\beta = 4.39 \text{ (from Table 1)}$$

The angle required is

$$\beta l = 12 \times 4.39 = 52.7°$$

Step 2—Refer to Fig. 5. The tan for an angle of 52.7° is 1.33

Step 3—From the formula $X_c = Z_0 \tan \beta l$, solving for Z_0 yields:

$$Z_0 = \frac{X_c}{\tan \beta l}$$

Assume that the same value of X_c obtained in Step (1) of Condition A will be used, since this is the same circuit. The value of the tan obtained in Step (2) is 1.33, therefore:

$$Z_0 = \frac{147}{1.33} = 110.5 \text{ ohms}$$

Step 4—Refer to Fig. 2 and for a Z_0 of 110.5 the ratio of $\frac{D}{d}$ is approximately 6.2. This is an awkward value since the outer conductor must be at least 6.2 times the diameter of the inner conductor, and a rather bulky cavity will result. The reason for this is the assumption made in Step (3). Obviously more capacity must be added for tuning to bring the cavity dimension to a more reasonable size.

Step 5—Since you are still limited by the 12 inch dimension, arbitrarily reduce the Z_0 to a value of, say, 80 ohms. From this new figure, now calculate the total capacity required to tune the circuit. From Step (2) the tan βl is 1.33 and

$$X_c = Z_0 \tan \beta l$$

therefore

$$X_c = 80\ (1.33) = 106.4 \text{ ohms}$$

Refer to Fig. 4, and on the 144 mc curve, 106.4 ohms is equivalent to 13 mmfd. Since we have already made an allowance of 4 mmfd for tuning capacity, bringing the total capacity to 8.5 mmfd, we must now add another 4.5 mmfd to resonate the tank.

Step 6—The total tuning capacity required is now 8.5 mmfd. Refer to Fig. 6 and, assum-

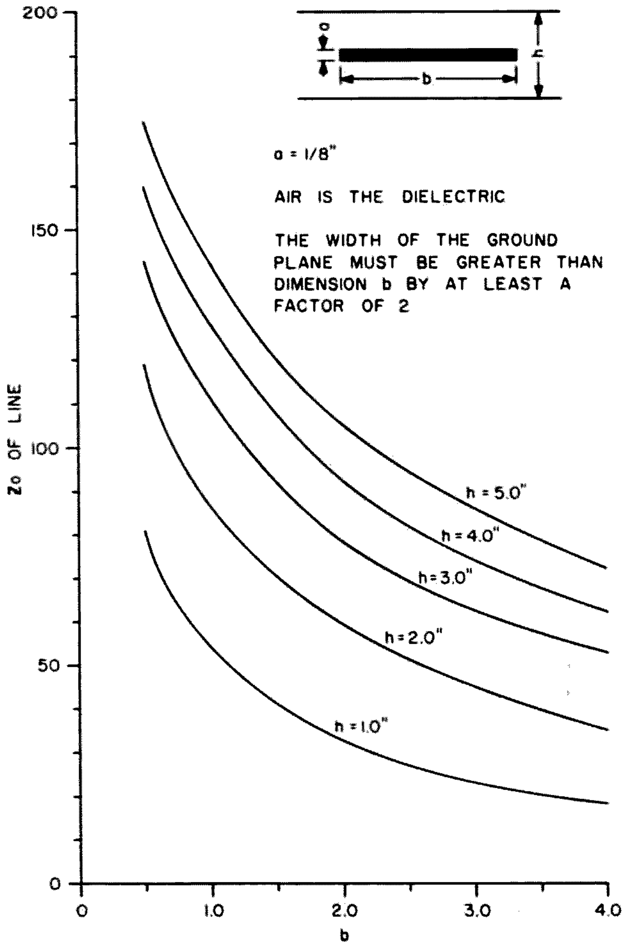


Fig. 8. Impedance of 1/8 inch strip lines.

ing .010 spacing, the plate area required is approximately 7.6 square inches, or 2 discs 1.6 inches in diameter. If you wanted more conservative spacing increase the size of the disc, but first make sure it will fit in the cavity.

Example 3—Trough Lines

Most trough lines are used as resonant line elements in receiver rf amplifier service. The sample calculation here will be representative of this type of design. However, trough lines are not limited to this design choice and can just as easily be used as a line tank for a 4X 150A tube.

For this case, assume the following:

(1) The frequency is 432 mc, and you are designing a plate tank.
(2) The tube is a 6CW4 nuvistor in a grounded cathode circuit with an output capacity of 1.5 mmfd.
(3) The line length should be as long as possible consistent with the above conditions, and a 2 mmfd maximum tuning capacitance will be used.
(4) The trough will be 1½ inches square, open on the top, with a ¼ inch center conductor spaced in the middle.

Step 1—Determine the impedance (Z_o) of the line from Fig. 3. For our case h = 0.75, w = 1.50, and d = 0.25. Therefore:

$$\frac{h}{w} = \frac{0.75}{1.50} = 0.5$$

To find the Z_o, the ratio of $\frac{w}{d}$ must be determined. In this case,

$$\frac{w}{d} = \frac{1.50}{0.25} = 6.0$$

From Fig. 3, the Z_o is 117 ohms.

Step 2—Now determine the value of X_c that will be effectively shunted across the line by the capacity. Total capacity = tube output capacity plus tuning capacity. $C_T = 1.52 + 2$, = 3.5 mmfd. Refer to Fig. 4 and for 432 mc the value of X_c for a capacity of 3.5 mmfd is 105 ohms.

Step 3—From the same formula used in previous examples,

$$X_c = Z_o \tan \beta l$$

we can now determine the length of line required. Substituting the values obtained, we have the following:

$$105 = 117 \tan \beta l$$

therefore:

$$\tan \beta l = \frac{105}{117}$$

$$\tan \beta l = 0.9$$

Refer to Fig. 5; this represents an angle of 42°.

Step 4—From Step (3) we know that βl = 42°, therefore, $l = 42°/\beta$. Refer to Table 1 and obtain the value for β, in this case 13.17 degrees per inch.

$$l = \frac{42°}{13.17°/\text{inch}} = 3.19 \text{ inches}$$

Therefore, the line must be no longer than 3.19 inches for the conditions specified.

Example 4—Strip Lines

Strip lines are being used more and more by VHF enthusiasts since they offer the major advantage of being simple to fabricate with a minimum of sheet metal and machine work.

For this example, let's assume the following:

(1) We will use a 2C39 at 432 mc.
(2) The plate tuning capacitance will be 2 mmfd maximum.
(3) The output capacitance of the 2C39 is 1.95 mmfd, assuming a grounded grid configuration, the output capacitance is the grid to plate capacity.

(4) We will use ⅛ inch thick line, 2 inches wide between ground planes, 2 inches apart. As stated previously, this means the minimum distance for the width of the enclosing section of the box is 4 inches.

Step 1—Determine the impedance (Z_0) of he line from Fig. 8. From (4) above, we find hat b = 2 inches, h = 2 inches and from 'ig. 8 the Z_0 is 59 ohms.

Step 2—Now determine the value of X_c hat will be effectively shunted across the ne by the loading capacity. The total capacy = tube capacity plus the tuning capacity.

$$C_T = 1.95 + 2 = 3.95 \text{ mmfd}$$

lefer to Fig. 4 and at 432 mc, the value of X_c for a capacity of 3.95 mmfd is 94 ohms.

Step 3—From the same formula used in revious examples,

$$X_c = Z_0 \tan \beta l$$

'e can now determine the length of line equired. Substituting the values obtained, we ave the following:

$$94 = 59 \tan \beta l$$

$$\text{therefore: } \tan \beta l = \frac{94}{59} = 1.59$$

efer to Fig. 5; this represents an angle of 8.5°.

Step 4—From Step (3) we know that βl = 8.5°, therefore $l = 58.5°/\beta$

efer to Table 1 and obtain the value for β, ı this case 13.17° per inch.

$$L = \frac{58.8°}{13.17°/\text{inch}} = 4.44 \text{ inches}$$

herefore, the line must be no longer than .44 inches for the conditions given.

Design Considerations

As a general rule for resonant line tank rcuits, you want to keep the line length, for given amount of loading capacity, as long as ossible. This can be done by making the aracteristic impedance (Z_0) of the line wer. In most cases a good rule of thumb is ot to use a (Z_0) lower than 35 to 40 ohms. his does not apply to parallel lines in air. r these lines about 100 ohms is about as w a figure for (Z_0) as you would normally se. Generally, for coaxial, trough and strip nes, (Z_0) values of from 50 to 77 ohms are esirable and for parallel lines a (Z_0) somehere between 250 to 300 ohms is desirable. you can keep your line designs close to the nge of figures recommended, the tank circuit ill have close to optimum unloaded "Q".

The next consideration is what wave length line should be used. This is determined by e following factors.

(1) space
(2) frequency
(3) loading capacity
(4) ease of mechanical layout

Bear in mind that a good ground rule is not to use any more multiples of a quarter wave length than you have to. The more you use, the greater the loss. For relatively few multiples, the losses are small. For example, if you are designing a coaxial grid tank for a 4CX250B to be used at 432 mc you will quite likely find that the first quarter wave is right in the middle of the glass header, due to the high input capacity of the tube and the associated mechanical construction of the grid. In this case it is clear that at least a half wave line will be required.

In Example 3 you determined that the quarter wave line length for the plate circuit using a 6CW4 should be no greater than 3.14 inches. This assumed a tuning capacity allowance of 2 mmfd that also includes any stray capacitance, etc. that you will encounter. This is a fairly marginal situation. It would be much better if we could have an allowance of say 4 mmfd. If the line were longer it would be a little easier to fabricate and work with.

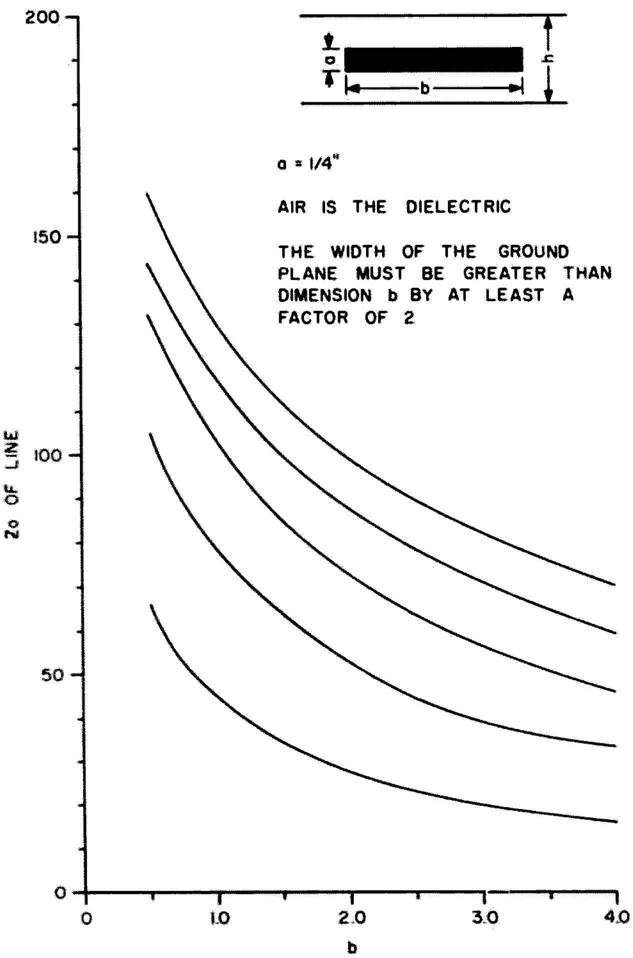


Fig. 9. Impedance of 1/4 inch strip lines.

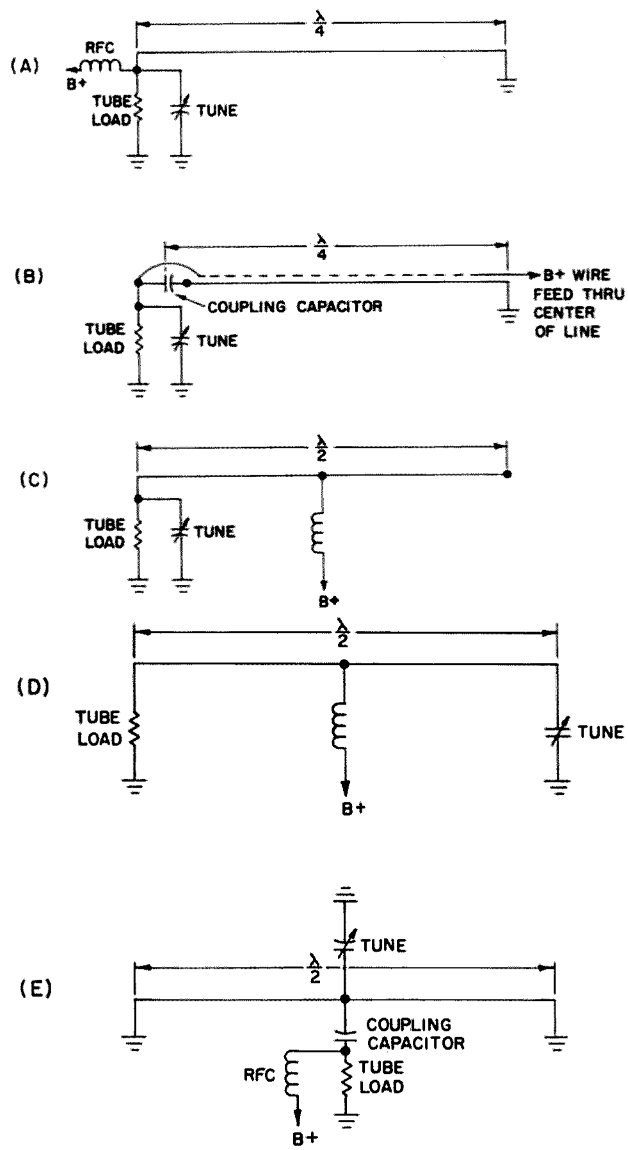


Fig. 11. Various tank configurations.

So instead of using a quarter wave line, use a half wave line. You have already calculated a quarter wave section of the line so now calculate the next quarter wave section. You are adding only 2 mmfd additional capacity so determine the additional length required for resonance.

Step 1—Refer to Fig. 4. For 2 mmfd at 432 mc

$$X_c = 185 \text{ ohms}$$

Step 2—The Z_o is the same 117 ohms, therefore,

$$\tan \beta l = \frac{X_L}{Z_o} = \frac{185}{117} = 1.6$$

Step 3—Refer to Fig. 5. 1.6 represents an angle of 58°; therefore,

$$\beta l = 58^\circ$$

$$l = \frac{58^\circ}{\beta} = \frac{58^\circ}{13.17^\circ/\text{inch}} = 4.4 \text{ inches}$$

Step 4—From this, and the data determined in Example 3, a half wave length should be

.19 inches plus 4.4 inches or 7.59 inches ng. The tube capacity will be 1.5 mmfd nd the maximum tuning capacity will be 4 mfd. This is an advantage since all the capacity does not have to be at one end of the ne. The tuning capacitor can be at one end upporting the line and the tube capacity can e at the other end. The net effect is the ame as if it were all at one end and the ther end was left free. Fig. 11 provides additional data on possible line arrangements.

For the most part, the examples given were resented from the conservative point of view oncerning the length of the line (1). This was one following the rule that it is easier to orten the line to bring it to resonance at the esired frequency than to add to it.

Fig. 11 shows various configurations of line ave lengths and some of the possible feed stems that can be used.

If at this point you feel quite confused, run rough a problem of your own and see for ourself that it is not as difficult as you might hink. Be independent and design that line r the new rig yourself.

. . . W6GGV

References

1) "Reference Data for Radio Engineers" Fourth Edition.

2) "Radio Engineers Handbook"—Terman, Fourth Edition.

3) "Formulas for Characteristic Impedance" Electronic Design, September 13, 1961, Page 173.

There is no Fig. 10.

Because of space limitations, we had to make the graphs in this article small and inconvenient to read. For $1, we'll send you an 8½ x 11 booklet with 9 beautiful full page graphs and a reprint of the text. Ask for "The Design of VHF Tank Circuits." 73 Magazine, Peterborough, N. H.

Gus: Part III

This little episode is being written while I am in Calcutta, India. I am feeling a little low today because I have just this morning seen my sweet wife, Peggy, leave for the U. S. A. and I am really lonesome. I should be returning back to the AC lands next week where I have a transmitter and at least can get on the air. Right at this moment some fellow out on the street who sells gadgets to passers by is playing a very mournful oriental tune on a flute and he has been at it for the past 3 hours.

I am standing by here trying to get my good equipment out of Customs. It has been referred to the Central Government in New Delhi by mail! Boy, I sure hope that Ministry will open my letter when it arrives so I can get my stuff and head back to the high Himalayas and get away from this hot weather here. You would be surprised at all the sounds you hear coming up from the street. The constant honking of those horns on taxis (they use those very old type of horns where you press a rubber bulb and they actually say "honk-honk-honk") and these fellows just love the sound that they make. My little hotel room is not equipped with an air conditioner but it has one of these old slow turning ceiling fans like you see in the movies of scenes taken overseas. The sweat is pouring from me.

The hams here in Calcutta have promised my wife that they will not let me get lonesome and I think a few are coming around to take me out tonight. They are a FB lot. VU2AJ, VU2RF, VU2DK, and many others have met Peggy and me and one or two of them shows up almost every night for an eye-ball QSO.

A new sound just started down on the street —one of these snake charmers with his flute and cobra is now at it and going strong. Well, I better get along with my story now; I have wandered long enough away from it, day-dreaming here in my solitary room.—I wonder if the band is open to W land now, it's 1300 GMT—or 6:30 PM Indian Standard time! No rig here, no nothing. You all back home have it made and don't know it! You lucky dogs you

Like I said in the last episode, I spent most of my time during the War building rigs and putting up a lot of rhombics and eating dinner every day with the Draft Board man! Final the war was over and the fellows everywhere were getting back on the air—and I was in there with the boys working 'em right an left. You know, when you get up 13 rhombics —big ones too—that keeping them up starts to become quite a task all within itself. It's practically impossible to walk around to inspec them all each week. I used my Jeep eac Sunday after lunch riding and riding looking over all those antennas, and usually at leas one was down, a guy wire broken, a rope broken. Then I would spend all day Monday getting that antenna back up and in operating condition. At times during summertime whe thunderstorms were prevelant lightning would completely remove all the wire from a whole rhombic or at times just half of it, but nev bothered any feed lines.

This sort of thing kept up quite a numb of years. Occasionally I would have a QSO with Buck Joyner W4TO over in Atlanta wh is a rep for a number of different radio man facturers. One of them at that time was Telre Buck would all the time say "Come on Gus why don't you put up a good beam. You know they are better than those rhombics you hav there." I would say to him, "Buck, I can wor anything you can and get just as good a r port as you get and you know I run just KW."

Well, one day I went out to inspect th antenna farm, and three of them were dow

That night here comes Buck again with his antenna argument and this time I said, "Buck, what kind of antenna do you have there that you want to *give* me?" He said, "Gus I got a brand new 5 element Telrex that's too long to put up on my place and it's yours for $100.00 if you will come to Atlanta and pick it up. It's still in the factory crate." I said, "OK, Buck I will try out one of those beams just to see if it's as good as my rhombics."

I got in my old beat-up pick-up truck, along with my man Pocket, and over to Atlanta we drove. When I left there I had a 5 element beam.

On my way home I was passing through a very small Georgia town and spotted a radio station where some fellows were taking down a nice little tower. I stopped in and ended up buying that 150 foot tower for $100.00. In the truck it went too. When I arrived back home I was all set: a good 5 element beam and a 150 ft. tower all for a total price of $200.

I had read lots of books on beams in the meantime and was ready to see how some of those writeups on tuning and adjusting beams worked out in practice. At first I just put it up and tuned it like the book sa'd to tune it, at the factory marks on the elements. The SWR was FB at the exact center of the band but, brother, by the time either band end was reached the SWR was way up—about 3.5 or maybe 4 to 1! I decided I couldn't make it any worse by tuning and adjusting by some other method. I had heard about this business of Gamma and Mega matching with small tuning condensers mounted in a weather proof box right up on the antenna, and this sounded fine to me. So they were installed along with a field telephone on top of the tower. Up the pole Pocket went and we started our tuning up. After many trials and errors you kind of begin to see the curious effects turning either condenser has. You plot a curve with the condensers at one setting, then you run another curve with another set of adjustments of the condensers. After a while you began to see which way things are going, and by some slight mis-adjustments (on purpose—that is) you find that the antenna can be used all over the whole 14 mc band with an SWR of not over 2:1. Of course it never gets at 1:1 on any frequency, but which is best: 3.5:1 on each end of the band with 1:1 at the center frequency, or 2:1 at each end and maybe 1.25:1 at the center? I liked the latter adjustment much better.

After that 5 element beam was up I began to compare it with my old rhombics and I found that the beam was just exactly as good at the rhombics at their very best direction, but with the beam I could fill in those weak spots between the rhombics! And the nicest part with the beam, I had only one antenna t keep up in the air! And the front to back ratio helped to eliminate a lots of QRM when working DX! So as one rhombic after another came down for one reason or another I just let them stay down! But I did lose my good 40 an 80 meter signal!

Since using vertical Hy-Gain antennas o DXpeditions I have a good idea on a fairly good way to overcome a low frequency antenna problem. I want to try this when I ge back home again: Run a 40 meter co-ax feedline to the proper place up near the top of the tower; then tap it on the tower and put out the 40 meter ground plane radials (remembering the loading effects of the 5 element beam on top). Slide up and down until you have the lo est SWR at the middle of the band, then try a tuning coil in series with the co-ax feed lin (to tune out the inductive of capacative reactance—whichever you have to tune out). Then you have a good ground plane that's up hig so you drop down the tower and find the rig spot for the 80 meter co-ax connection and it ground plane. (Remember the top loading effects of both the 20 meter beam and also the top loading effects of the 40 meter ground plane wires too.) When you get through wit the 80 meter ground plane, I believe yo could do the same even with a 160 mete ground plane. When all is finished you then would have up a good 40-80-160 meter vert cal ground plane and also a good 20 met beam. Then put on top (this should be done before you start the low frequency verticals a good 10 and 15 meter beam, and then everything is on one tower! I have found th a good vertical with a low SWR like the H Gain that I used on all my DXpeditions hard to beat. I do know Old Buck W4TC proved his point to me more or less—that to say, a good 4 or 5 element beam, up high just as good as a fairly good rhombic, of cours only on one band. With these 5 over 5 or over 6 beams, I suppose that they are bett than a run-of-the-mill rhombic. These fellow using stacked jobs are very hard to beat.

All during most of the 1950's I kept thinkin about my very slim chances of going on DXpedition to any rare country. The chan of such a thing ever happening was, in m opinion, one in a million. But I did start mak ing some plans just in case something di eventually turn up.

To start with I though how nice it woul be if a fellow could write with one hand an use the other hand to operate his key. All m

fe I had been using my right hand both to rite and send with. I was talking to a friend mine who had studied the human brain and ɔw it functioned and I asked him if it were ɔssible for me somehow to learn to use my left and to write while keeping my right hand to ɔerate the key. He told me he had read in ıe of his books how to do this and that he ould look this info up and give me a phone ıll if he found it. A few weeks later he lephoned me to come and see him.

When I arrived there he told me how to go ɔout trying to change my writing hand. Here what he told me to do. For two weeks I as to stand up in front of a mirror with one ınd on top of my head and the other hand on y stomach, then to pat my head with the ınd on it and at the same time to rub my ɔmach with the hand that was on it, then to y "change" and to rub the hand on the head vhen rubbing, the hand should be going in circular motion) and to pat the stomach with e hand that was on it. This did take two eeks really to get so you could change in-antly from rub to pat and vice versa! About) minutes each morning I practiced this. All is time I was told to do all my writing with y left hand but to keep on using my right ınd on the key while operating the rig.

Well, back to my doctor I went, and demon-rated to him that I had accomplished my as-gned task. Next he told me to change the ɔsition of my hands, explaining that he meant r me to put the other hand on my head and e other on my stomach and to practice this r two weeks and to report to him then.

This task was perfected in two more weeks, ıd my writing with my left hand was getting ɛtter (I could almost read it!—hi). Back I ent to him and he made me demonstrate ;ain—with him telling me when to change ɔm rubbing to patting and vise versa. He id, "Gus you are doing fine, but you have ıly begun to work; there is more to learn yet!" e said, "From here on I want your wife to ve you the commands when to change. I ınt you to be able to use either hand on your ad or stomach. Let's start using numbers ɔm now on. Number 1 will be right hand on ad patting while left hand is on stomach bbing. Number 2 will be right hand on head bbing while left hand is on stomach patting. ımber 3 will be left hand on head patting ıile right hand is on stomach rubbing. Num-r 4 will be left hand on head rubbing while ght hand is on stomach patting. Let your fe do the counting, 1 2 3 4, 1 2 3 4, then 3 2 1, 4 3 2 1, then 1 2 4 3, 4 3 2 1 etc. Do is for one month and come back to see me."

I was working like a slave on this darn assignment and my wife was laughing her head off at me or bawling me out for being so silly! But you know me, I am hard headed. I was going to learn to write with that left hand or else.

One month later it was back to the doctor's office again. This time he did the counting and boy, I jumped when he gave those 1 2 3 4, 4 3 2 1 etc. commands. But I satisfied him that I could do the exercises 100% perfect. (You know, I used to have plenty of hair on my head, and I wonder why it's so thin now? Maybe all that rubbing and patting had something to do with it!)

My writing with my left hand was beginning to get sort of almost legible too. My wife said to me one night when I was doing my exercises, "How crazy can you get?" I guess I could not blame her for this remark when you sit down and think about these things I was doing either! You know, about this time I got a letter from my bank wanting me to come down and give them a new signature card—I wonder why?

Well, back to the Doc and me—Next he said for me to keep doing these 1 2 3 4, 4 3 2 1 exercises but everytime I change from one number to another for me to be patting one foot with the other foot still and then to change feet! You know, this was getting to be a complicated thing, and was turning out to be lots of hard work! He said to do this for 6 months, to keep writing with my left hand while transmitting with my right hand, to put a Coke on the table, then while I was writing to stop and pick up the Coke and take a drink while I was still keying with the right hand, then to light up a cigarette while I was still using the key, and to get all this down to where it was a smooth operation and perfectly coordinated with both hands. (You see, I had told the Doc why I wanted to become left handed in my writing, explaining to him about DXpeditions, the necessity of speed in filling out logs while using the key—he understood the problem.)

Well, in 6 more months I had things down to perfection. I went back and demonstrated to him and he even came out to the house and let me show him how it work out while I was actually in QSO with someone. He said to me, "Gus boy, you have it all O.K. now; you don't need me anymore," and that was that! I must say this has helped me out in speeding up QSO's when those piles get real high and you have to work em, to get the pile down, where you can control em!

I used to listen to W4KFC and W3BES in those SS contests and their system of operation was an education all by itself. I als learned a lot listening to ole Nose KH6IJ ou in Hawaii too. I was getting ready for anythin in the line of operating that the future migh bring my way. Of course I was all the time o the air working what DX there was, and tryin to out-guess the other fellows who were m competition. During those times I was tryin to make as many good friends as possible over seas with the hope that some day I would ge the chance to visit them and at the same tim not have to be paying a hotel bill! Oh yes, will admit most of my motives had two view points but I think both of them were hones viewpoints.

All during these years those trees on m farm kept on growing and growing and diffe ent people in the lumber business kept o making me offers to buy the timber. Most c the offers were made by small timber buye and did not amount to much, but eventuall one of the larger companies came to see m and said they were making a serious offer c so-and-so many dollars for the timber I ha Well, I had no real idea as to what the timbe was really worth, but I just told them I woul not consider selling at the price they offered m but I would sell them if they would pay m that same day a figure about 35% higher the what they had offered me. I said for them t go back to their office and make their ow decision and if they wanted to make the pu chase just to bring me the money before 6 p that same day—or to forget the whole thin but not to come after that day because th timber would not be for sale at any pric They left at about 2:30 pm and back the were at 5 pm with a certified check for th amount I had asked. The papers were signe they had departed and the next day I we down to a bank and deposited their chec

I said to myself, "There is my DXpeditio money." I never did mention this to the wif Then I kind of gradually started telling som of the DXers overseas that I might come an visit them the next year if they had a spa room for visiting hams. If they said they ha the room for me I said FB and if they did n answer my query I just forgot about them.

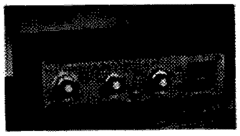
The plans for a DXpedition were slow i developing at first, but after a while the new got on the grape-vine that I was going on DXpedition and then the fellows started as ing me where was I going—and to be hones up to that time I did not have the faintest ide where I wanted to go or where I should g I asked different DXers what countries the needed and the answers at first were usuall Tanna Tuva or Wrangle Island. Then I woul

ell them to be reasonable and they would sually mention a few countries that it was ossible for me to visit. I wanted to go to as nany good spots as my little money would ake me, but I knew the money would have o be stretched very thin if I went to too many. But I had my mind made up how I would perate when and if I ever got going. I vould never have any Black List; I would ever work anyone on my frequency; I would ot start this business of having someone in he USA or elsewhere assist me with giving list of stations to work; none of this W1, W2, V3, etc. business. I wanted to be the one to un my DXpedition the way I wanted to run t: no favorites, come one, come all, no holds barred.

About this time I started wondering about getting licenses overseas, getting equipment to ıse (I had nothing small or portable at all), he various language barriers, Custom troubles vith radio equipment, the health problems, etc.

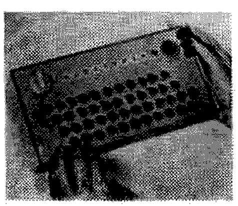
In the next episode these things begin to tart getting solved—things start moving—and problems start coming up that have no solu-ions—or at least I could see no solutions to hem. I said to myself many times—Come on Gus, don't chicken out now!— . . . Gus

New Products



One KW — $99.95

Looks as though Heathkit is determined to take over the ham SSB market. Their new HA-14 "KW Kompact" linear is the smallest yet—and only costs $99.95. It's just 3-3/16 x 12-3/16 x 10 inches too. The HA-14 runs 1000 watts PEP to a pair of 572-B's on 80 through 10 meters. It even has a SWR bridge built in. The HP-14 mobile power supply is $89.95 and the HP-24 AC supply is $49.95. Find out more from Heath, Box 73, Benton Harbor, Michigan.



Codetyper

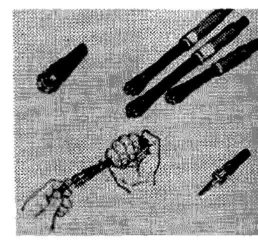
Here's something that we've all been looking for for quite a while. It's the Computronics Engineering Model 400 Codetyper, a subminiature keyboard code generator. It uses 21 transistors and an internal NiCad battery. Relay contact output is provided for transmitter keying and a built-in speaker provide 1000 cycle tones for monitoring and code practice. Speed is continuously adjustable from 5 to 55 wpm. Key action is momentary snap-action with electrical lockout during character plus space duration. Price: $299.50 from Computronics Engineering, Box 6606, Metropolitan Station, Los Angeles, California.

Speech Clipping Mike

American Microphone Division of Electro-Voice has brought out the new D-501K hand-help, transistorized, speech clipping communications microphone. It can easily be substituted for the original mike on most communications equipment, and can deliver up to twice the "talk power." The mike clips the loud, unimportant vowels to let the more important consonants get through better. Power for the D-501K is supplied by a small, internal long-life cell which can easily be replaced. An internal control is provided for clipping depth. Price: $49.50. Contact Lynea Dalrymple at E-V, Buchanan, Michigan 2N107.

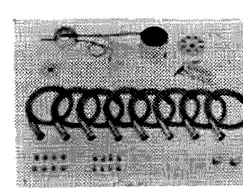
VHF Associates

VHF Associates is adding to their line c VHF equipment. Now in addition to thei varactor triplers, and converters for 432 mc they've announced a superregenerative de tector-modulated oscillator transceiver for 42 mc. It could provide a lot of fun for the UHI beginner or old timer. They also have an nounced a noise generator for the HF, VHI and low UHF range. Get the full informatio from them: VHF Associates, P. O. Box 22135 Denver, Colorado 80222.



Tip Wrench

G and G Tool Company has brought out a interesting new gadget. It's called the Ti Wrench and is used for tightening and loosin hex and square nuts and bolts, and deep slotte machine and pan screws. You press the plung er head with your thumb to pick up the nut then the wrench holds it firmly while you fas ten it. The tool comes in four sizes for use witl nuts and bolts from no. 2 to no. 12. G and G P. O. Box 1005, Thousand Oaks, Calif. Ohio.

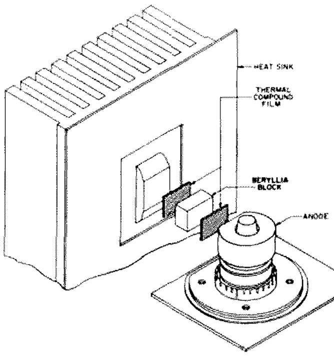


Electro-Shield Noise Suppression Kit

Estes Engineering is making the new Electr Shield noise suppression kit for mobile use It's in semi-assembled form to fit a wide variety of engines. The kit provides complete shielding and filtering for your car ignition system Installation of the kit is very quick and only requires trimming of spark plug cables, attaching fittings at trimmed ends and inserting on engine. More information from Estes Engineering, 1639 West 135th Street, Gardena, California.

Certificate Holder

Tepapco has brought out the ideal match for their popular plastic QSL card display packets. Now you can protect your certificates and display them on the wall. Price is $1 for 3 packets which hold 15 certificates. Tennessee Paper and Box Company, P. O. Box 198, Gallatin, Tennessee.



.mperex Conduction Cooled 4CX250B

Well, you can throw away those blowers ɔu've been saving. Amperex has developed new type of tube that is good for 270 watts ıtput (CCS) at 432 mc with no blower, 'ater, or wide open space. It uses a new ɔnduction cooling system that uses a heat sink ı dissipate power that doesn't go out the ›edline. The number of the conduction cooled CX250B is the 8560. Amperex Power Tubes : Hicksville, New York, can give you more ıformation on this interesting idea.

Vacuum Nozzle

The Radio Vacuum Nozzle is a semi-flexible lastic reducer to fit on the end of an ordinary ıcuum cleaner hose. It can be bent on the ıd to get behind and between parts on a ıassis for cleaning out noise making dust. : is cast in one piece, so there are no parts ı get mislaid, and can be hung on a peg-oard. Cleaning out a rig can more than pay ɔr it by boosting trade-in value. The price is ıly $1 postpaid in the U. S. from Grace pitz, Box 4095, Arlington, Virginia 22204.

Ham Global Time Watch

Here's a useful product for the DX'er: a lobal wrist watch that will tell you the time ıywhere in the world as well as giving the ›cal time. The Swiss-made jewelled move-ent is anti-magnetic and has a luminous dial, sweep-second hand and an unbreakable main ɔring. Price is $16.46 including FET from lordlung Radio Products, 7635 West Irving ark, Chicago, Illinois.

FM Schematic Digest

Amateur FM activity on the VHF bands is increasing at an incredible rate. There are a number of reasons for this, not the least being the availability of surplus commercial FM gea at prices so low as to make you blush. An important help in getting this fine gear on th air is the new *Motorola FM Schematic Diges* that gives you the complete information o adapting Motorola gear for ham use. It's available from Two Way Radio Engineers, 1100 Tremont Street, Boston 20, Mass. for only $3.95 postpaid.

Photocell Applications

Rufus Turner has been at it again. He's go out a new book that gives many simple an complex applications of the many photocells distributed by Lafayette Radio. The 84 page book is called *Photocell Applications* and is available from Lafayette for only $1.50. You' find it very interesting.

Mobile and Marine Station License Manual

Leo G. Sands' new *Mobile and Marine Station License Manual* published by Sams wil be of great interest to many hams. Though i is not directly concerned with amateur radio many hams work with or would like to wor with commercial two-way radio. This book answers virtually all of your questions abou station licenses, type-acceptance, equipmen standards, allocations, etc. A copy plus a commercial license could provide significant spare time income for the knowing ham. $6.95 fro your local distributor.

Getting Started

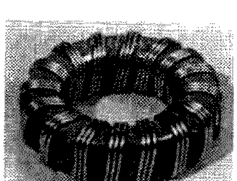
Rider's *Getting Started in Amateur Radi* by W2PIK and W2MDL will answer many o the questions that newcomers have about amateur radio and will help them get their l censes. It covers learning the code and theory and regulations for the novice and gener exams. A few of the regulations may b changed by the FCC soon, but that will affec only a small part of the book. One of th appendices include FCC regulations. $2.9 from your local distributor.

Charts and Nomographs

Some hams seem to have a dread fear o math. Others don't mind it, but try to avoi lengthy calculations. Allan Lytel's *Handboo of Electronic Charts and Nomographs* solve both of these problems. It contains 58 electronic and mathematical charts and nomographs that will give you answers to you electronic questions with slide-rule accuracy in the time it takes to draw a line. Price i $4.95 and it's available from your distributo

EICO Full Line Catalog

Many new products are featured in the new 1965 EICO Full-Line catalog. The 36 page catalog is completely new in style for better readability and convenience. It contains well over 200 pieces of ham gear, test equipment, Hi-Fi gear, etc. Every piece of equipment in the EICO line is included and described in depth. You can get a copy from EICO, 131-01 39th Avenue, Flushing, N. Y. Tell 'em 73 sent you.



Toroid Balun Kit

Ami-Tron's new Toroid Balun Kit will make a broad band (80-6 meters) 1:1 or 4:1 impedance ratio balun good for 500 watts or more. It will give you an improved match for beams, quads, vees, windoms, dipoles, etc. The kit includes a ferrite core balun, lots of #14 Formvar insulated wire, and complete instructions. Price is $5. You can get more information from Ami-Tron Associates, 12033 Otsego Street, North Hollywood, California.

W2NSD from p. 4.

rangement. The car was waiting for me in Frankfurt and I drove it from there down to Ctuttgart, Zurich, Luzern, Geneva, Turin, Venice, Trieste, Zagreb, Graz, Budapest, Vienna, Prague, Nuremberg, Warzburg, Hannover, and left it at Hamburg for shipment back to Boston. About 3000 miles.

Due to the hospitality of amateurs along the way and the inflated price of the not yet imported VW, my trip probably cost me less than $200. You know, Cowan is right, I am tight with a dollar . . . he says (I hear) that NSD stands for Never Spend a Dime. That's me.

Besides putting me even further back in answering my mail, the trip was a bit of a vacation and immensely valuable in moving the Institute of Amateur Radio ahead. Rather than go into a long hassle on the politics of amateur radio, I will start things moving and see if we can't get some valuable progress before ARRL can throw a wrench in the works.

One of the most encouraging things that happened during the trip was my visit to Geneva for the centenary celebration of the ITU wherein I had an opportunity to talk freely with amateur representatives of many foreign countries. I am very happy to report that the U. S. stands just about alone among the major amateur radio countries of the world in its lack of action toward the survival of our hobby. I don't think I can even express in words the concern that other countries feel over this unhappy situation. I found the influential amateurs in these countries to be most anxious to be cooperative . . . and this, amazingly enough, also includes some of the "iron curtain" countries.

The ARRL, by the way, was conspicuously absent in representation at the ITU affair, though I did work Dick Baldwin on 20 meters from 4U-ITU. ARRL's absence did not go unnoticed.

As time and space permit I'll try to cover some of my interesting visits. My return just before final presstime prevents me from carrying on at length this month. Count your blessings. I must tell you that my short visit to Yugoslavia, Hungary and Czechoslovakia have whetted my interest in a visit to the Soviet and a meeting with some of the hams there. Many of them called me during my two week spree on twenty before the trip and said that they read 73 and hoped that I would make plans to visit.

This travel stuff is heady . . . I start day dreaming. I could fill a lot of space here with my supposin trips. I should keep my feet on

the ground and my butt in my office chair and work at 73 but I do like the idea of visiting UA-UQ-UR, or even more fastastic, teaming up with some similarly naive ham for a drive in a rugged car from Tangier down the west coast of Africa to Capetown, operating a ham rig in as many spots as possible. Those Land Rovers aren't very expensive in England and could probably be sold for a good part of the price in South Africa. I've talked with quite a few hams who live along the way and they say it can be done. I'd sure like to get a chance to talk personally with the government radio authorities in a lot of those countries and tell them how wonderful amateur radio is and what a great thing it would be for their country if they would encourage it there . . . and how we will help them to do this.

Aren't dreams fun?

WAZ et al

One thing that seems to be worrying the certificate hunting crowd is what will happen to the various commercial awards that CQ is selling such as WAZ, USACA, and all that if CQ should decide to stop selling them or perhaps go out of business. Since these awards are copyright by CQ there is no way that they can be perpetuated by any other magazine or organization.

Clubs

It would be more than prudent to have your club secretary write to 73 for our special Club Plan. This unusual offer combines a special low introductory subscription price to 73, cash for the club treasury and free books for the club library or to be given away as door prizes at meetings.

Channel A

Let's get those CB rigs up on ten meters and bring our ham band back to life. The national calling frequency is 28.6 mc. When that gets crowded we'll go up to 28.65 and 28.7 mc. The first response to this plan has been enthusiastic. How about it, will I see you there?

VHFer

The VHF contingent of amateur radio is in luck. Loren Parks K7AAD, of Parks Labs has put together 6up and the VHF'er (previously published by a VHF manufacturer in Michigan) and came up with a fine monthly VHF magazine. The subs are $2 a year for those of you who were not subscribed to either of the parent publications. Write VHFer, Route 2 Box 35, Beaverton, Oregon. I suspect that everyone but Loren will benefit from this new arrangement. Send him articles and subscriptions. . . . Wayne

VHF

Bill Smith KϕCER
1301 Churchill Ave.
Sioux Falls, S. D.

OSCAR III is still circling the earth opening the door of space-age amateur radio wider. After over one-thousand orbits the 144.850 beacon continues to send back HI's and telemetry indicating a battery voltage of approximately 4 volts.

A wealth of information has been, and is being, obtained. This is the topic of this month's column.

I attended a recent VHF dinner in the Twin Cities where WB6JZY, a Sylvania engineer and avid OSCAR Association member, spoke. In brief, this is what he said:

OSCAR III was one of nine satellites ejected from the single launch vehicle. The number was a new record from one vehicle. The other eight satellites were governmental. Their purposes were not disclosed and pictures of the launch were not allowed.

An apparent miscalculation placed the satellite in an orbit about twice as high as planned, and right in the middle of the Van Allen radiation belt. This, coupled with one of the largest solar flares in recent years shortly after the launch, probably explains the premature failure of the translator.

The extra height of the orbit accounted for the repeated signals being weaker than expected. The additional signal loss was about 12 db.

It is believed the 144.950 mc beacon never functioned because of a collision with one of the other satellites at ejection breaking off the steel tape-measure antenna.

The QSB is thought to have been caused by one, and/or, two things. The satellite should have been ejected in a stabilized orbit but apparently the tension of the ejection spring or the collision with another satellite caused OSCAR to pitch at one rpm.

The rapid build-up, and sharp cut-off, of the white noise has been blamed on insufficient isolation between the input and output of the translator. Needed was about 138 db of isolation. This amount was never obtained. Probably more efficient shielding or more than 800 kilocycle separation in the input and output channels would help. This lack of isolation caused the translator to feed white noise into the 144.1 input stag, the noise was then sent back into the output, building up in strength until it saturated, broke down, and then the process repeated itself.

OSCAR IV is ready to go up at anytime and is identical to III. It was III's back-up and was also taken to the launch site. The Association says they will probably launch it sometime in early fall. I am betting it will be re-worked some before they do, however.

Plans are already underway for OSCAR's V through X and the Association is looking for suggestions on what to do with them. Suggested so far have been 432 beacons, 1296 beacons, cross-band translators and the like. They want to know what YOU would like up there.

There is also a possibility that future satellites will have an OUTPUT power of 12 to 15 watts. Space has been offered on one of the new nuclear-powered satellites and the power is available for a nuclear power OSCAR, no less!

Most of the parts that went into OSCAR's III and IV were donated by various companies because of company interest. The rest of the expense—and it was terrific—was borne by the Association. The Association is NOT soliciting donations to help out on future projects, but I'm sure they wouldn't turn them down. It is the least WE can do.

Much has been said and discussed about the types of antennas that were used. Success was had with most any type, but circular polarization with an elevation ability paid off the best in the opinion of the Association and others who were set up to make checks through switchable polarization on given passes.

Circular polarization is not new, but it has not been used to any great extent in amateur circles until recently. There are several means of generating circular polarization and knowing little about this myself, I have asked for assistance from several of those who do.

WϕLER is one of these. John has made available information on this topic and some of his ideas, along with those of some others, should be in the August issue. WϕCUC and I are in the process of building and testing several systems. I had hoped to have it ready for this issue but do not feel that we have it to the point where we could present it in proper fashion. The August issue should allow time for those of you who are interested in constructing a circular system in time for OSCAR IV. Also being tested is Gain, Inc.'s commercial antenna with selectable horizontal, vertical, right and left hand circular polarization. (Ed. note: Cush-Craft makes one, too.) The results of these tests will also appear next month.

Several letters have been received from those of you who are just starting on VHF. From the questions that have been asked it would appear that those of us who take pen in hand have been badly overlooking the newcomer.

This is a problem I hope to lessen with information primarily directed at the newcomer in the form of an article.

Also, I am wide open for suggestions and am looking for additional column material in the form of short construction articles, handy gadgets, measuring noise figure, pre-amps, improving converter, receiver and transmitter operation and so forth. Some of these seemingly minor things to us may be just the thing someone else is looking for. How about it?

. . . KϕCER

SEMICONDUCTORS

Paul Franson WA1CCH
Peterborough, N. H.

The first item this month is a slight goof last month. The 2N3478's are NPN, not PNP as shown in the schematic. The polarity of the supply voltage is shown correctly.

Because of delays in getting the transistors and being sidetracked on other matters, I am not ready to report my results on the 2N3478 converter I built. However, W1OOP, who is accepted as *the* converter man in these parts, has been working extensively with 2N3478's and reports that he is down to a 5 db noise figure with a 3-cavity filter followed by 2 rf stages and a mixer. The cavities are for selectivity but do degrade the noise figure slightly. Hank has a single input cavity preamp in front that brings the works down to 3.6 db. We hope to have the details on this in *73*.

The 2N3478's aren't just good for amplifiers, of course. It may be sacrilegious to some to use low noise amplifiers as oscillators, but they are inexpensive and perfect for oscillators, crystal oscillators and multipliers—though an Amperex 1N3182 variable-capacitance diode (i.e., varactor) at 88c makes a fine multiplier and is a little simpler. I built a little emitter-dip-oscillator using a 2N3478 to simplify construction of some 432 mc equipment. My old GDO is rather bulky. You take the coils to it, not it to the coils. Most transistorized dip meters use a small diode detector for sampling the rf to give an indication of resonance. I find it easier to measure the emitter current. A class C oscillator draws less current when it's not oscillating—or at least not oscillating as vigorously when it's coupled to a resonant circuit of the same frequency which absorbs part of the energy.

We've had a number of questions about varactors. A number of companies make them: Motorola, TRW, Microwave Associates and Amperex seem to be the most popular with hams. High power varactors are expensive compared to the surplus material most of us are familiar with, but they are very economical compared to the new tubes, sockets, power supplies and modulators that can be used to get on 432 mc. For instance, the 432 mc rig in the '64 *ARRL Handbook* uses two 6939's at $11.90 apiece for about 5 watts on 432. By comparison, I've been using the Amperex H4A (1N4885) which sells for only $15 retail. It's good for 13 watts of CW output at 432 and is the cheapest high power varactor I know of. I'm using a circuit similar to the one by W9SEK in the March *73*. There were other articles about varactors in the October '64 *73*, by W6ORG, October '62 *QST* by W1OOP and January *CQ*.

One of the handicaps to high power transistor rf stages (other than the price) is the problem of getting

decent gain at the 13.5 volts available in most mobile applications. You either have to use a number of transistors in parallel with extra drivers or use an inverter to furnish a higher voltage. Motorola has been interested in this problem because of their prominent position in the mobile communications field. They've developed some new rf power transistors (2N3717 and 2N3718) made for operation from car batteries. They're expensive and work better at 25 volts than 13.5, though. Maybe cars will double their voltage again.

Another aspect of the same problem is the high DC current required for high power inputs at 13.5 volts. 50 watts at this voltage requires almost 4 amps. That takes a bulky tank. Compare that to the 1/10th of an amp at 500 volts a typical tube would use. But tubes do require filaments. A satisfactory solution is instant-heating tubes, such as the extensive line that Amperex makes. They use 1.5 volts for the filament rather than 13.5 volts since the lower voltage makes a more reliable filament. A one or two turn loop around the toroidal power supply core as in HV rectifiers in TV sets takes care of the filament. The new Transcom transistorized SSB transceiver uses a pair of 8042's—the instant heating equivalent of 6146's.

Here's a rather dramatic example of the advantages of he new cheap consumer transistors that I've been discussing the last few months. The 2N918 is a good old eliable NPN UHF transistor that has been around for uite a while. It appears in many applications bulletins ecause it works well as an amplifier and oscillator, as in UHF TV. It ought to. It sells for $14.20 (Motorola). he new Motorola MPS918 is similar except for higher issipation and lower temperature rating and is made for he same uses. But it's in a glob of plastic instead of a ermetically sealed case. Price is $1.35 for one. The newer MPS3563 at $1.20 is made for the same purpose. ither would be excellent for dip-meters, mixers, VHF mplifiers, etc. Other transistors in this Motorola line are he NPN MPS2923-5 at 65c to 75c for low-level *if* and audio uses.

I said last month that I'd try to explain the common transistor parameters this month, but it looks as if I'm unning out of space. I'll try again.

Someone wrote in to ask where you buy the transistors 've been mentioning. You don't buy them from the manufacturer. You buy them from industrial wholesalers. ewark Electronics in Chicago will send you their fat catalog with both ham and industrial listings including many of these transistors if you mention 73. Be sure to get it. Other mail order distributors such as Lafayette and Allied and large local ones carry them, too. In some cases, they don't list the transistors in the consumer catalog you get when you send in the coupon in *Popular Electronics*, but they still have them hidden in their industrial catalogs. They love to give away the consumer catalogs—that's why they don't advertise in 73; you've already got the catalogs and don't need to write for another—but they are a little more stingy with the industrial es. You normally need letterhead to get the industrial catalog. Also, Poly Paks, Alco and Transistors Unlimited d other mail order companies often have the older ransistors at good prices.

Don't forget to write.

. . . WA1CCH

Corrections

On page 52 in the June issue, the B+ is grounded n the schematic. Don't do that.

On page 82 in June, remember that the plate circuit isn't really grounded. There is a blocking capacitor t the cold end of the line.

On page 88 in June in the schematic, the transistors hould be indicated as NPN. The supply polarity is own correctly.

In the May 73, there is an article entitled the "Constant Gain Audio System." A better title would be the "Constant Output Audio System."

Also in May, in the article on Log Periodics: Page 62, second column. σ' (the mean spacing factor) quals $\sqrt{\tau}$ (tau) not $\sqrt{T}$. On page 63, second column, l/a is 300 at 52.5 mc, not 600. This will change a few dimensions in the example. Also on page 63, first column, Za = 120 (Loge h/a — 2.25) ohms, not h/a = 2.25.

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SPRINGFIELD ARC HAMFEST. Springfield, Ohio Clark County Fairgrounds, Sunday, July 18. Program will feature talk on Ham TV by K8AOH. Contact WA8FZS, 212 Galewood Drive, New Carlisle, Ohio.

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INTERNATIONAL WATERTOWN-GLACIER HAM FEST. July 17 and 18, Watertown Lakes Park, Watertown, Alberta. Box 223, Red Deer, Alberta.

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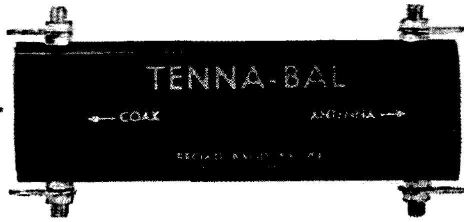

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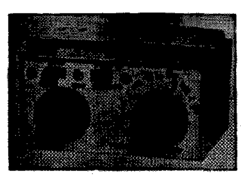

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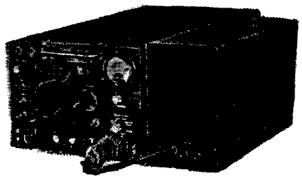

ALL-BAND SSB RCVR BARGAIN: Hallicrafters R-45/ARR-7. 550 kc to 43 mc continuous: Voice, CW, MCW: 2 RF's, 2 IF's: S-meter: 455 kc Xtl. 6 select. choices. Ready to use, w/60 cy pwr sply & book, aligned, fob Los Angeles **199.50**

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Same with keyboard, C $89.50, U	69.50
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TG-26B, like #19 but tape, C $139.50, U	99.50
40 rolls oiled tape 11/16" wide	11.95
#15 w/keybd, sync. C $149.50, U	95.00
Handbook TM 11-352 for Mod. 15	7.50
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QUESTIONNAIRE?

1. Without looking back through the magazine try listing here the advertisements that you remember as being of interest to you in this issue of 73.____________________

____

____

2. Is there a good chance that you may purchase something advertised in one of these ads?

____

3. Which article did you find most interesting in this issue?____________________

____

4. Now please glance through this issue and list here the ads which you feel are not satisfactory. ____________________

____

____

5. Is there any particular piece of equipment that you would like to see us test?____________________

____

____

(If you don't like to shred your magazine put the answers on a separate card or paper.) Send answers to 73, Peterborough, N. H.

INDEX TO ADVERTISERS

Propagation Chart

July 1965

J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7*	7	7	7	7	7	7*	14	14	14
ARGENTINA	21	14	7*	7	7	7	14	14	14	14*	21	21
AUSTRALIA	14	14	14	7#	7	7	7	7	7#	7#	14	14
CANAL ZONE	14	14	14	7	7	7	14	14	14	14	14	14
ENGLAND	14	7	7	7	7	14	14	14	14	14	14	14
HAWAII	14	14	14	7	7	7	7	7#	14	14	14	14
INDIA	14	14	14	7#	7	7	7#	14	14	14	14	14
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INDIA	14	14	7#	7	7	7	7#	14	14	14	14	14
JAPAN	14	14	14	7	7	7#	7#	7*	7#	7#	14	14
MEXICO	14	14	7	7	7	7	7	7	7	7*	14	14
PHILIPPINES	14	14	14	7#	7	7	7	7*	7	7	7#	14
PUERTO RICO	14	14	14	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	7#	7	7	7#	7#	14	14	14	14	14	14	7#
U. S. S. R.	7*	7	7	7	7	7	7	14	14	14	14	14

WESTERN UNITED STATES TO:

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ARGENTINA	21	14	14	7	7	7	7	14	14	14	14	21
AUSTRALIA	14*	14*	14*	14	14	7	7	7	7#	7#	14	14
CANAL ZONE	21	14*	14	14	14	7	7	14	14	14	14	21
ENGLAND	14	7#	7	7	7	7	7#	14	14	14	14	14
HAWAII	14	21	21	14	14	7*	7	7	14	14	14	14
INDIA	14	14	14	14	7#	7	7	7#	14	14	14	14
JAPAN	14	14	14	14	14	7	7	7	7	7#	14	14
MEXICO	14	14	14	7	7	7	7	7	7*	14	14	14
PHILIPPINES	14	14	14	14	14	7#	7	7	7	7#	7#	14
PUERTO RICO	14	14	14	7*	7	7	7	14	14	14	14	14
SOUTH AFRICA	7#	7#	7	7	7#	7#	7#	14	14	14	14	7#
U. S. S. R.	7*	7	7	7	7	7	7	7	14	14	14	14
EAST COAST	14	14	14	7	7	7	7	14	14	14	14	14

Very difficult circuit this hour.

* Next higher frequency may be useful this hou

Good: 1, 2, 5, 6, 10-13, 18-21, 25-31

Fair: 14-17, 22

Poor: 3, 4, 7-9, 23, 24

VHF DX: 3-8, 12, 17-19, 27

73

50c
(Not 75c, not even 60c)

Amateur Radio

Amateur Radio Report Card

Public Service	A
International Good Will	B
Inventiveness	B
Activity	A
DXing	B
Moonbouncing	A
FCC	F

73

Magazine

Wayne Green W2NSD/1
Editor & Publisher

Paul Franson WA1CCH
Assistant Editor

August, 1965

Vol. XXXIV, No. 1

3 Magazine is published monthly hank heavens it's not weekly) r 73, Inc., Peterborough, N. H. ip 03458 (terrible number). The ione is 603-924-3873. Subscription tes $4.00 per year, $7.00 two years, .0 three years world wide. Second ass postage is paid at Peterborough, ew Hampshire and at additional ailing offices. Printed in New ampshire, U.S.A. Entire contents pyright 1965 by 73, Inc. Postasters, please send form 3579 to od Old 73 Magazine, Peterorough, New Hampshire. Don't foret your zip code when you renew change your address.

de W2NSD/1

never say diet

The Docket

There is, I am relieved to report, growing pressure to have the FCC put 15928 aside until some sort of study can be made of the whole situation. You can help this movement by sending a letter to the FCC requesting that 15928 be killed outright or that the time for filing comments on 15928 be extended for six more months. It will not hurt one bit if you send this letter via your own personal Senator or Congressman so that he can include a little note of his own when forwarding it to the FCC. The deadline for such a note is July 30th, so you'd better get going.

We've got major troubles fellows, and we're going to have to pull a strain to get out of them. We've got the FCC against us for one thing . . . and that's bad. Even worse, we've got the ARRL against us. That doesn't leave us much, does it?

I can hear you now . . . there goes Wayne Green running down the ARRL again. Who the heck does he think he is? OK, let me tell you who Wayne Green is and what he knows. My ham career started out in Brooklyn almost 30 years ago. I was a teenager on roller skates and I visited every active ham that I could find in Brooklyn . . . I still run into those old timers on the air who remember my visits. I got my ticket in 1940 . . . was active on 160-40-10-2½ meters . . . won the SS contest for my section in 1941 and was extremely active right up to and including December 7th. No one can buffalo me about the old days . . . I was there . . . I know what the hams then knew . . . how little they knew . . how they built rigs from the Handbook and Radio, but had to call in one of the local "experts" when a 6C5 crystal oscillator wouldn't perk. Sure there were a few complex rigs, but most of the gang were struggling with their 6L6 oscillator modulated by a 6L6 Don't hand me any guff about the technical level of the old timers . . . I was one . . . and I knew the rest of them.

The ARRL in RM-499 claimed that they had detected that we have been going down hill and apparently they have convinced the FCC of this too. My response to 499 was a letter asking the ARRL to give any facts they had to support their claim that something was wrong with amateur radio. They did not answer my request . . . they *can't* answer it for there are no facts to prove this fallacy. On the contrary, all the facts indicate that ham radio is better and more valuable than it has ever been.

Let me get down to brass tacks. One of the biggest complaints we've been hearing is about "appliance operators." OK, I'm an appliance operator . . . my rig is a transceiver, commercially made, even my antenna and tower are commercial products. I don't see any reason to spend the time and effort needed to build a transmitter today any more than the hams of 30 years ago saw any need for building their receivers. But I do build my RTTY converters and whip up anything else special that I need. Between the VHF gang . . . take a look at the July VHF issue of 73 again and see for yourself, the surplus users . . . see our June issue, the RTTY gang, the TV gang, and a dozen or so other gangs . . . plus the fello

Updating the R-S-T reports.

R means readibility.	
R-1 to R-4	Unreadable
R5	Readable with difficulty to armchair copy
S means signal strength.	
S-0 to S8	Too weak to copy or too much QRM to copy
S9	Readable with difficulty
S9-plus	Reasonably readable signal to thunderous signal
T means tone.	
T-0 to T8	Pulses or raw ac note
T9	Rough note or bad chirp
T9X	Anything from absolutely perfect signal to one complete with chirps, thumps, clicks, a bit of hum, buzz, parasitics, etc.

all over the country like Bill Hoisingtor K1CLL who love to build and design things we are doing just fine. A look at the 1940 han magazines in comparison to the 1965 will tel you the same story . . . even the average han today is way way ahead of the average ham o 25 years ago. Way ahead.

I'm not trying to sell you a bill of goods . . these are facts. Check for yourself. Would yo like an experience? Build up something fron an issue of 73 and then take it around to a club or two and show what you've done. I bet you will find that a number of the clu members will ask you questions that will amaz you about your unit. I've had this happen t me too many times . . . and the worst of a are the high school radio clubs . . . some o those kids are incredible. Don't believe m . . . ask anyone that has made the rounds o ham clubs with any kind of technical talk.

If we're all appliance operators then who is i that is buying all that surplus gear? I've bee trying to get Meshna to run bigger ads an he won't because he is selling all he ca handle right now. 85% of our readers say the buy surplus gear and our surplus advertise back this up with some amazing stories o sales.

OK, what else? Bad manners on the ai Sure . . . I run into 'em now and then. But i all the years I've been operating . . . and a the thousands of stations I've contacted, I'v run into darned few bad manners. Someho every time I do have troubles it seems to b from just a small handful of fellows, cha that I've gotten to know as troublemake Unfortunately, we have virtually no way t get these jokers off the air. Bad manners is a exaggerated problem. I've operated from se eral rare DX spots and almost without excep tion I've found that everyone was as cooper tive as I could ask. When I operated well got good results, when I goofed it things g messed up . . . and I could take the easy w out and blame myself, but experience h taught me how to handle pileups so that ever one gets worked and everyone is happy . . when it doesn't work this way for me it is m own fault. I can sympathize with the DX cha who is sitting there dying a slow death waiti for the DX station to stand by and is afra that the band will go out before he can ma the QSO. This can be very nervewracking a lead to chaos if the DX station tries to igno it . . . bad manners? Baloney.

Hams don't invent things anymore. Yea Listen chum, before you start telling anyo

Turn to p. 86.

Robert Ruda W2BHT
60 Knollbrood Road
Rochester 10, N. Y.

This One Sounds Good – Like a Transmitter Should

For some reason or other, going mobile has meant spending a good sum of money for a rig that most likely offered three times the features that the average mobile ham needed. Or, if the ham was a build-it-yourselfer, it usually meant sacrificing audio quality or transmitter power or operating convenience. This may have been because of cost, space limitation, or just because no one, aside from a few commercial units, had taken the time to design a quality prototype, field test it for months to remove and bugs, and then re-build the final proven design.

Well, all you potential mobile hams, here is an article on just such a design: a mobile (or fixed-station) transmitter complete with all the features you'd like, the size you need (only 3 inches high), and even where to put each component and wire to assure identical

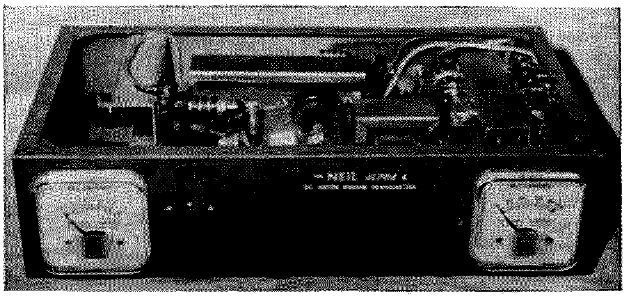


Fig. 2A—Front View: This is the original prototype, and does not have a crystal socket on the front panel.

results with the final prototype, which by the way was field-tested for three years with no breakdowns or operating problems.

It would be easy to write several pages on the superiority of this transmitter, but the outstanding features are that it tunes easily, and it "sounds better." This has been attested to by every signal report we've received. "It's the finest sounding rig we've ever heard," and, "I can't believe you're running only 20 watts—sounds better than any hundred watt rig I've heard." This is characteristic of the glowing reports we've had with this transmitter. And it happens every time we make a new QSO!

What makes this so? There are no gimmicks, no special components. The answer is that the rf section is *stable*, and a great deal of time was spent in designing and testing the audio section. The audio passband and power were carefully designed to provide superior audio, and were not merely "something" that would modulate the final stage. The speech amplifier is highly filtered, an

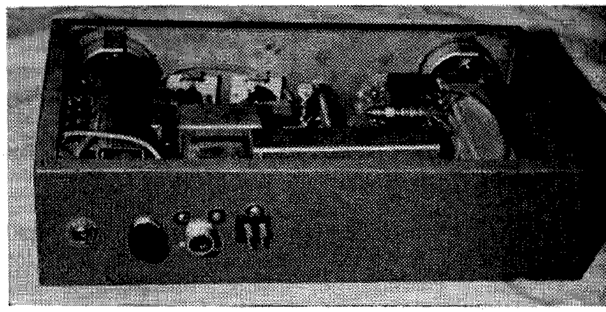


Fig. 2B—Back View: Note components mounted on back panel. From left, mike input, gain control, antenna output, 4-pin power input plug.

stable. Yet it contains no tricks, is easy t[o] build, and is not over-designed. In fact, th[e] modulator by itself will improve the signa[l] quality of most 20 watt AM transmitters i[n] use today.

Design Philosophy

The transmitter was originally intende[d] for mobile operation, but the finished uni[t] performed so well that one is currently bein[g] used as the main 6 meter transmitter a[t] W2BHT. Since the greatest local mobile ac[-]tivity is on 6 meters, the transmitter wa[s] designed to cover this band, though it ma[y] easily be converted to 10 meters by the prope[r] choice of coils.

Single-band operation was selected mainl[y] for simplicity, and because it was found tha[t] most of the local mobile hams on 6 meter[s] rarely used any other band for mobile activit[y]. Twenty watts input was chosen not becaus[e] of size limitation, but because of intelligen[t]

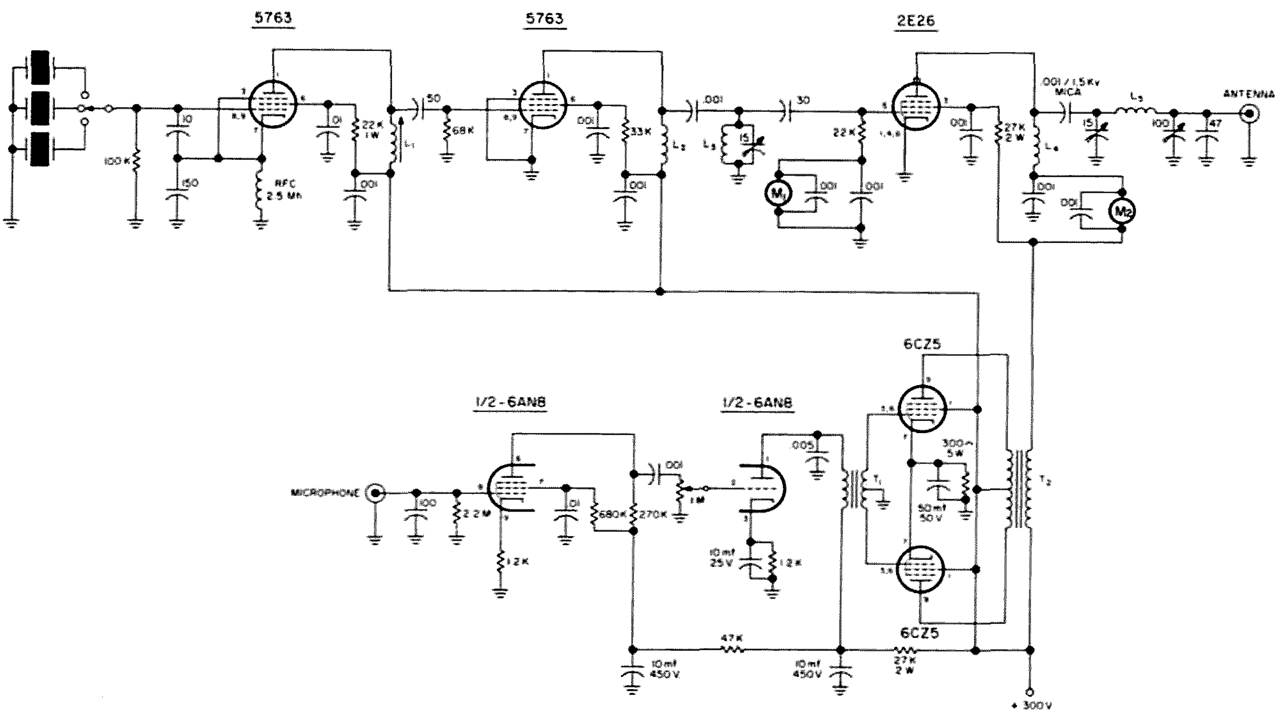


FIGURE I

attery drain and power supply requirements. .nd, as has been borne out by all who have uilt this transmitter, it will out-perform ome-brew and commercial units with 2 or 3 mes the power. The unit we built contains 3-position crystal switch and socket in addi- on to a crystal socket mounted on the front anel. In this way we could seal in two net ·equency crystals with the third position ving us an additional crystal frequency from ıe front panel, or, as in our home station, roviding us with an easy vfo input.

The first reaction we received upon showing ıe transmitter was, as we anticipated, "why vo panel meters?" Simple. We're operating

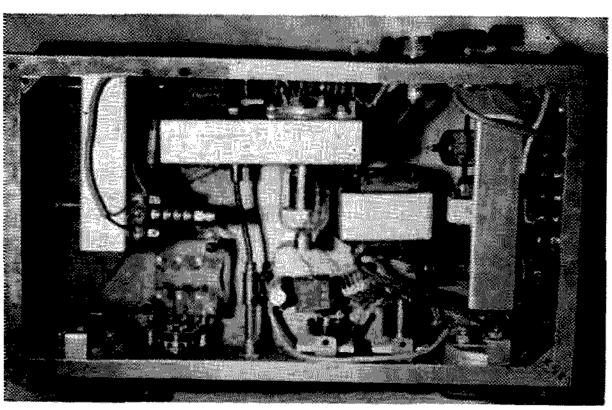


Fig. 2C—Looking into the Transmitter: The Exciter Sub-Chassis is the vertical chassis at the left. The Modulator Sub-Chassis is the vertical chassis at the right. The Final Chassis is shown near the back. Note placement of components on front panel and location of Modulation Transformer between the 2E26 tube and the Interstage Transformer mounted on the Modulator Sub-Chassis.

Parts List

- L1 Approx. 2 microhenry slug-tuned coil, North Hills Electric 1300F or equivalent
- L2 7 microhenry RF choke, Ohmite Z-50
- L3 5¾ turns of B&W 3002 miniductor
- L4 2½ mh rf choke
- L5 5 turns of B&W 3010 miniductor
- M1 0-5 ma meter
- M2 0-100 ma meter
- T1 1 to 3 ratio interstage transformer, single plate to push-pull grids
- T2 10 watt modulation transformer, 8000 ohm primary to 5000 ohm secondary

The parts values are not critical, and any reasonable substitution can be made.

mobile. How nice to be able to read plate and grid current to the final stage constantly, without meter switching. A real boon when we want to either QSY quickly or make sure the drive is adequate when we crystal-switch without taking our hands from the steering wheel or microphone. Besides, a good rotary switch costs about a buck, plus resistors and wiring. The extra meter can be had for just over a buck. So why not put in this desirable feature, which by the way is also a good conversation piece.

When tuning the transmitter, there are no screwdriver adjustments to make, and no coil adjustments which were so prevalent in other 6 meter transmitters when this one was designed. All tuning is done from the front panel, and instead of requiring minutes of tedious tuning, this little doll can be put on the air in less than five seconds, anywhere in the 6 meter band. And furthermore, no overtone circuits with their tricky adjustments are employed. Inexpensive 8 mc crystals can be used.

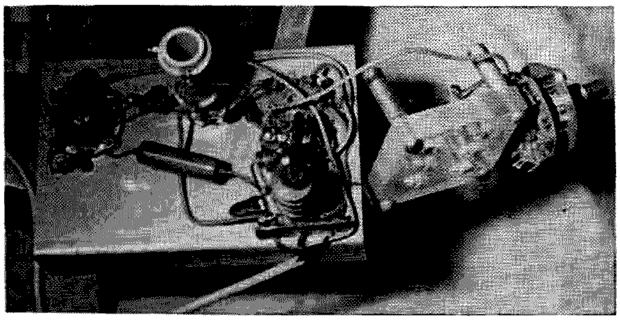


Fig. 3—Exciter Sub-Chassis: Also shown is the crystal socket and switch.

The Oscillator and Multiplier are contained in two separate tubes. The advantages? The power available from the 5763 Oscillator is more than adequate to drive the following 5763 Multiplier. Because of this the stage can be broad-banded. Once set, it needs no adjustment over the entire 6 meter band. Thus a tuning control is eliminated, saving space, simplifying construction, increasing reliability, and greatly decreasing the time spent in tuning or frequency changing. The two tubes are so operated that the total cathode current is no more than a suitable dual-tube would require.

All that need be said about the Speech Amplifier and Modulator is—wait until you receive your first signal report. You'll glow! There is plenty of audio to 100% modulate the transmitter, and the modulator automatically limits overmodulation by uniquely turning to square wave.

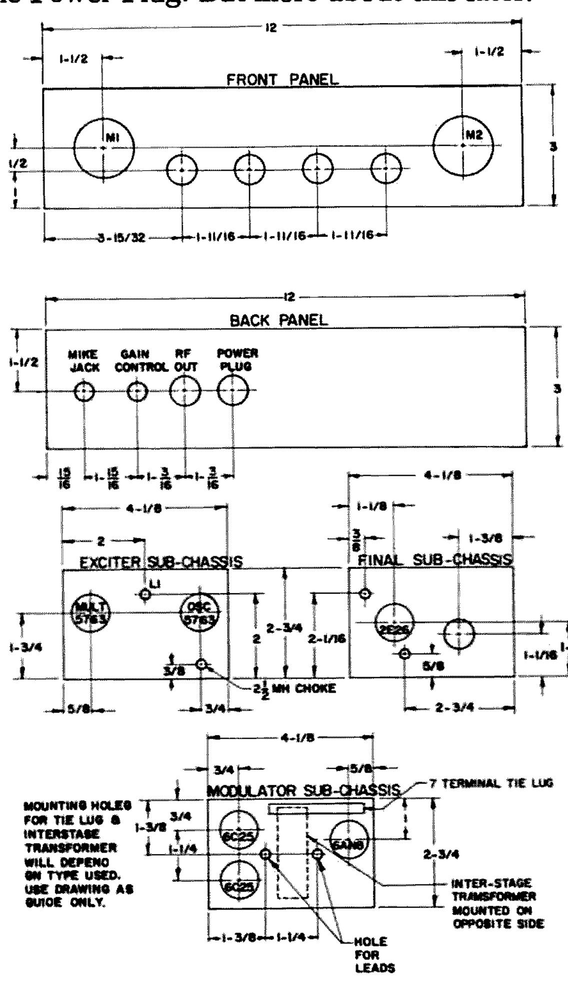
If by now you aren't eager to build and operate this amazing transmitter, either mobile or fixed station, it's probably because you're operating 400 watts right now. For once you get the pleasure of tuning up this rig, and hear the same high quality signal report every time, you'll never want to operate any other low power 6 meter rig again. And if you've just built or bought a 6 meter transmitter—well, you'd better build this one right away, while you can still sell the other one.

Simplified Construction

For a cabinet we used a chassis 3" × 7" × 12" upside down. It could be made a little smaller, but this chassis is readily available commercially.

The schematic is shown in Fig. 1, but we've made it really easy for you. Fig. 2 shows a photo of the front and back panels and bottom section, along with a dimensional drawing so that you can easily mark out the holes to be drilled. The entire unit consists of three sections or sub-chassis, plus the larger chassis cabinet. Each of the three sub-chassis is an open-end aluminum chassis 2¾" × 4⅛" × 1", available at any radio supply house. Follow the three drawings for drilling the sub-chassis. These are the Exciter Chassis, consisting o two 5763 tubes and circuitry; the Final Chassis, consisting of a 2E26 (6893); and the Modulator Chassis consisting of a 6AN (12CT8) and two 6CZ5 tubes and associated circuitry. Mount the components as shown i the three photos, and wire according to the schematic—using the photos as guides fo component and wire placement. Because the transmitter is built on three sub-chassis, bea the following in mind when wiring the sections.

EXCITER SUB-CHASSIS—As shown in th photo, mount a 2-terminal plus ground tie lug on this chassis. Use one lug for B+ plate and screen wires, and the other for the A+ (filament) wire. Connect the ground lug to the lug on the Power Input Plug on the rea of the chassis that will be used for commo B−, A−, ground. Do not ground this lug a the Power Plug. Each of the three sub-chassi must have its own ground wire connecting to the ground lug on the Power Input Plug even though each sub-chassis is used as common ground for its own circuitry. This wil give each sub-chassis its own negative lead to the Power Plug. But more about this later.



DIMENSIONAL DRAWING

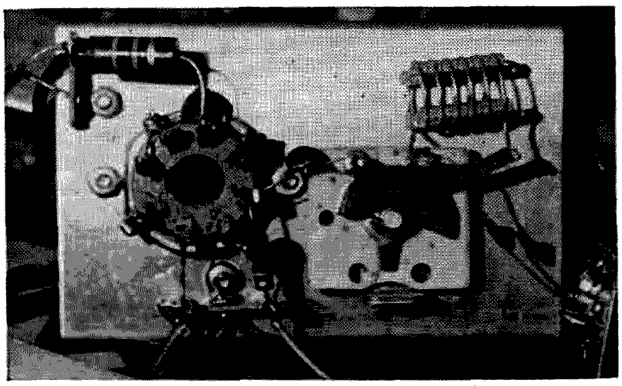


Fig. 4—Final Sub-Chassis: Screen resistor is shown at upper left. Coupling capacitor, .001 mfd mentioned in text, is shown at lower right.

When you connect the .001 mfd capacitor to the 5763 Multiplier plate, leave the other end hanging with a one inch lead. This will later be connected to the variable capacitor on the Final Chassis.

FINAL SUB-CHASSIS—Mount a 2-terminal plus ground tie lug as shown in the photo. The 22K ohm grid resistor will connect to one terminal along with a 15 inch length of wire which will later be connected to the Grid Meter on the front panel. Connect the filament wire to the other terminal. Also mount a 1-terminal tie lug, as shown, to which you will connect the screen resistor, and later on, the modulation transformer and Plate Meter wire.

MODULATOR SUB-CHASSIS – Connect the microphone jack to the 6AN8 socket on this chassis with a short length of wire. The jack will be mounted on the back panel at the same time the Modulator Sub-Chassis is mounted. The Gain Control on the back panel is connected to the Modulator Sub-Chassis by two 3 inch lengths of shielded wire. Do not cut the primary leads of the modulation transformer, but connect them full length to the 6CZ5 tubes. This transformer also will be mounted the same time as the Modulator Sub-Chassis.

Mounting

After wiring the sub-chassis, take the main chassis-cabinet. Mount on the front panel, from left to right as shown: Grid Meter; leave next hole open for crystal switch; panel bearing to which will be connected the variable capacitor mounted on the Final Sub-Chassis by a 3 inch flexible shaft; 15 mmfd variable capacitor; 100 mmfd variable capacitor; Plate Meter. On the back panel mount the Gain Control, Power Plug, and antenna coax connector as shown.

Mount the Exciter Sub-Chassis on the left as shown, mounting at the same time the crystal socket and crystal switch. Now back to the ground connections we were talking about. Using 3 separate wires or a 3-conductor cable, connect the 2-terminal plus ground tie lug to the B+, A+, and ground terminals on the Power Input Plug.

Mount the Final Sub-Chassis in the center rear as shown. Connect the .001 mfd capacitor from the Exciter Sub-Chassis to the variable capacitor on the Final Sub-Chassis. Connect the A+ filament terminal on the tie lug to the A+ lug on the Power Input Plug. Connect the ground terminal on the tie lug to the ground lug on the Power Plug. Connect the 15 inch lead to the Grid Meter. Ground the other terminal on the Grid Meter. The B+ will be connected later.

Attach a 3 inch flexible shaft from the variable capacitor on the Final Sub-Chassis to the panel bearing on the front panel. Connect a plate cap, output coupling capacitor, output coil, and 52 ohm coax to the front panel variable capacitors, antenna connector and rf choke. The photo of the top view will aid you here, using the schematic for exact connections. The rf choke connects from the plate cap to the Plate Meter. The other meter terminal connects to the 1-terminal tie lug on the Final Sub-Chassis through a shielded lead.

Mount the Modulator Sub-Chassis on the right. At the same time mount the microphone jack and modulation transformer. Connect the 2 shielded leads to the Gain Control. Select the wires on the secondary of the modulation transformer corresponding to 5000 ohms, and connect one to the 1-terminal tie lug on the Final Sub-Chassis. Connect the other to the B+ terminal on the Power Input Plug. Do not solder the lead to the 1-terminal tie lug until after the testing section.

Special Filament Consideration

If fixed operation is intended with a 6 volt filament supply, wire the filaments as shown. If mobile operation is considered with a 12

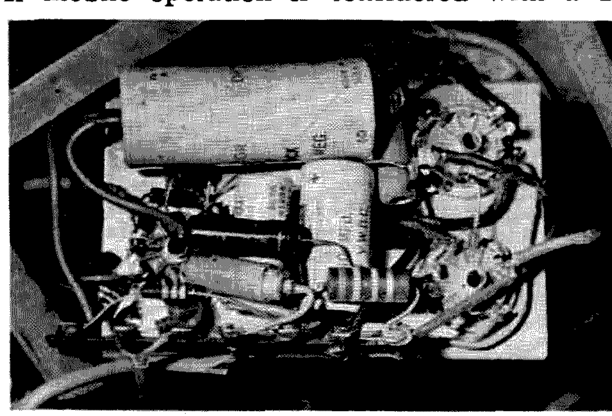


Fig. 5—Modulator Sub-Chassis: The two 6CZ5 sockets are at the left. The choke in the photo was wired in the filament lead of the 6AN8. It was later found not to be necessary, but was left in.

volt filament supply, make the following changes.

Wire the two 5763 tube filaments in series. Replace the 2E26 tube with its 12-volt equivalent, 6893. Wire the two 6CZ5 tube filaments in series. Replace the 6AN8 tube with a 12CT8 tube (direct replacement).

Testing

Install the Exciter tubes and the 2E26 (6893). Do not yet install the Modulator tubes. Plug in a crystal. Temporarily disconnect the modulation transformer wire connected to the 1-terminal lug on the Final Sub-Chassis. Connect a 300 volt, 200 ma, 6 volt, 3.6 amp (12 volt, 1.8 amp) power supply to the Power Input Plug and adjust the slug coil on the Exciter Sub-Chassis for maximum reading on the Grid Meter. If the recommended coil is used, the slug will be about ½ inch out of the coil. Disconnect the 300 volts. Re-connect and solder the modulation transformer wire. Install the tubes on the Modulation Sub-Chassis.

Tuning

The transmitter is extremely easy to tune. The general procedures are as follows: Close all 3 variable capacitors (full capacitance). With power applied, crystal or vfo connected, and antenna connected, turn the knob connected to the variable capacitor on the Final Sub-Chassis to get about 2½ ma reading on the Grid Meter. Then turn the 15 mmfd variable capacitor mounted on the front panel for minimum reading on the Plate Meter. If this reading is about 60 ma, tuning is finished. This will depend upon antenna being used. If this reading, however, is much below 60 ma (45-55ma) turn the 100 mmfd variable capacitor mounted on the front panel until the Plate Meter reads slightly over 60 ma, and again turn the panel-mounted 15 mmfd variable in the same direction as before for minimum reading on the Plate Meter. That's all there is to it. Easy? You bet!

Use a high impedance crystal or dynamic microphone, and do not ruin the superior audio ability of the modulator by rewiring for a carbon mike. About a ¾ turn of the Gain Control should provide the correct gain with the average crystal microphone.

You now have a compact transmitter that will literally give you years of trouble-free, high-performance operation. And when your first QSO tells you you've got the finest sounding rig he's heard—and what? You're only running 20 watts?—Sounds like 60! Just sit back comfortably and smile. After all, it's not your fault he didn't build one of these units too. . . . W2BHT

Going RTTY: Part III

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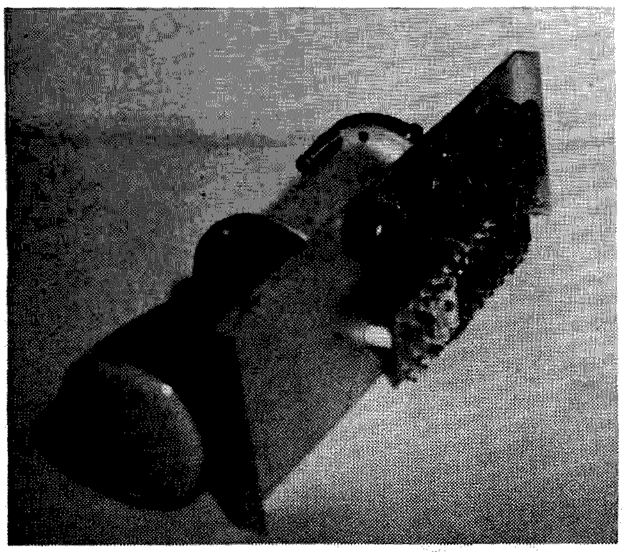
The Scope Monitor



Scope subchassis.

Tuning RTTY signals without the use of a scope monitor will be found to be a difficult job to say the least. In fact it is almost next to impossible, so every good RTTY set-up should include such a device.

In designing the complete converter we included a scope monitor and the photos shown with this article which appeared in 73 for December 1964, clearly indicate how it was fitted into the completed unit.

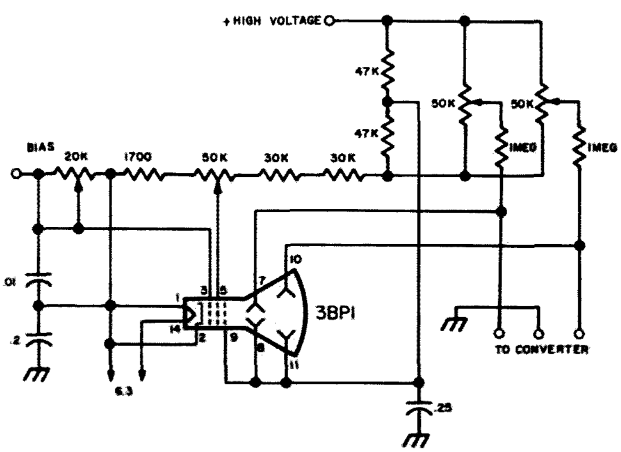
In order to make the circuit simple, no amplifiers are used since there is sufficient signal delivered to the deflection plates of the 3BP1 for good scope presentation.

In Fig. 1, the power supply connections are shown, since the power supply provided for the converter circuit is ample to handle the scope monitor. See Fig. 2 in the converter article. Simply make the connections at the right point on the original circuit and you are in business. Construction details can be seen in the accompanying photo. All wiring is done on one side of the sub-chassis to a terminal board. The two pots shown are the horizontal and vertical controls. The focus and intensity controls are mounted on the front panel.

The sub-chassis is three and three-quarters inches wide by 12¾ inches long, with a one half inch flange at each end.

After completing the wiring as shown in Fig. 1, fit the sub-chassis into the overall chassis and fix into position with self-tapping screws. This part of the converter is dressed up by using a Millen bezel No. 80073.

After wiring is completed, turn the converter power supply on and adjust the vertical and horizontal controls and then with an incoming signal applied, adjust the focus and intensity controls.



Schematic of scope.

The pattern which should appear when the signal is properly tuned is a cross.

Tuning by the scope monitor is easy, as you have a visible indication of when proper tuning is achieved since the scope presentation will be a perfect cross, if the shift of the transmitting station is correct. Here again a little practice will soon give you the necessar skill to quickly recognize the proper patter when it appears on the scope.

. . . W4RWM

Jack Bayha W8BPY

Imagineering with Meters

All too many hams seem to feel that when they need a meter to do a certain specific job, they have to have exactly the meter required, and don't realize that within certain limits you can make almost any meter do any job. If we had a buck for every meter someone has blown out trying to make it read kilovolts, and every meter someone has given up on, for being too slow when they tried to make it read heavier currents, I could buy the Taj Mahal. This doesn't happen because we don't have the knowledge, it's because we lack imagination, and refuse to apply the knowledge properly.

Bearing a few good basic principles in mind, we can do wonders with surplus meters. Let's look at the basics.

1. The more sensitive a meter is, the less energy it takes to go to full scale, and the more versatility we have. Don't sell a 100 microamp meter short. It can be made to read most anything. In general, we can make a meter read what we want it to, except we cannot make it more sensitive unless it has a shunt or a multiplier in it, then we can do most anything.

2. Use the fact that a one milliampere basic meter is rated at *1000 ohms per volt*. Thus a 100 microampere meter is 10,000 ohms per volt, and a 50 microampere meter is 20,000 ohms per volt. Remember the one mil is 1000 ohms per volt. This will allow us to make any kind of voltmeter we want out of any milliameter or microammeter we can get.

3. Most meters of the D'Arsonval type ar actually millivolt meters and actually read a voltage, in millivolts, developed across a shunt. Often you will see a meter with a little designation in the lower left of the dial FS-50mv. This means that no matter what the dial says, the basic movement is 50 millivolts. By changing the shunt, you can make it read almos any range.

4. We have two ways, and herein lies a trick, or *combinations* of these ways, to alter a meter's range. We can use a multiplier (this is a series resistor), or we can use a shunt; (this is a parallel resistor.) The multiplier will be used to make a voltmeter; the shunt to extend current ranges. Oddly enough the most common current meters for higher ranges use a millivolt meter as the basic movement, while voltmeters use current meters.

Now let's apply some basics. Look at Fig. 1 Let us first assume that the meter is a one milliampere unit. Remember that 1000 ohms per volt rating. (Incidentally the meter will usually have a resistance of 100 ohms, an unless you want to make a meter under 10 volts full range, forget it. Under 10 volts subtract this 100 ohms from the multiplier resistor value.) If we want to make this meter read 200 volts at full scale, we need mere to make R a resistor of 200,000 ohms. To make it read 500 volts, R must equal 500,00

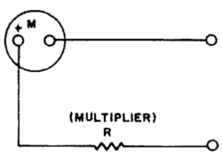


FIG. 1

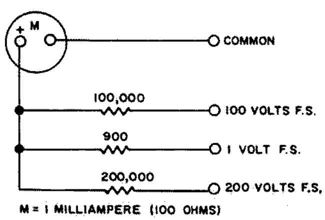


FIG. 2

Meter Multiplier Chart—Voltmeters
Meter Sensitivity

0-100 ma.—10 Ω per volt *
0-10 ma—100 Ω per volt *
0-1 ma—1000 Ω per volt
0-100 μA—10,000 Ω per volt
0-10 μA—100,000 Ω per volt

* Watch multiplier resistor wattages.

ohms. One caution to be observed is that it is a good practice not to allow over 300 volts to appear across one physical resistor; so, to make 500,000 use two 250,000 ohm units. Now if the meter were a 100 microampere unit, we would use 2,000,000 ohms to make it read 200 volts. Remember it is rated at 10,000 ohms per volt.

Simple application of the above principles will allow you to make an accurate voltmeter out of any reasonably sensitive meter you may have. When you get up above 10 milliampers full scale, or if you will, 100 ohms per volt, watch out for power ratings of resistors. Think in terms of ohms per volt for voltmeters and you have the problem licked. You may apply the same principles to extend the range of a voltmeter. Usually you will find the basic movement listed on the dial. You may also, if the basic range is adequate, go inside a meter rated at a much higher voltage rating and pull out the present multiplier and make it read what you want it to by calculating a new multiplier, and installing same.

Naturally, by installing the multipliers externally and switching them in, you can make a multiple range meter readily. See Fig. 2. (Note the 900 ohm resistor for the one volt range; in lower ranges, you must include the meter coil's resistance in calculating; in the higher ranges, this gets negligible so is forgotten.)

The above principles are very simple and a little imagineering on your part should take care of most voltmeter problems. Remember, keep the voltage drop across a resistor less than 300 volts, and put the resistor in the plus lead of the meter. (Viewed from the back, this is conventionally the left hand terminal.)

Extending the range of current meters, or making millivolt meters or microameters read currents of magnitude can be simple, or complex. It all depends what basic meter you start to work with. The easiest thing in the world is to take an existing meter, which reads relatively high currents, and extend its range. Measure its resistance, and put the proper shunt across it. This is the simplest kind of ohms law calculation. The meter meas-

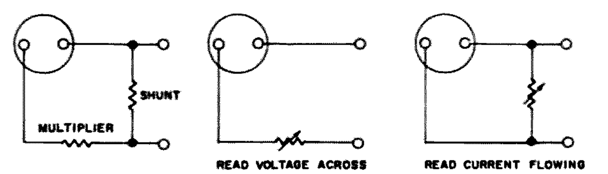


FIG. 3

ures 5 ohms, and reads 200 milliamperes at full scale. Want it to read 400 mils at FS? Put a 5 ohm resistor across it, and presto, half the current through the resistor, half through the meter, 400 mils full scale. This is as simple as calculating the value of two resistors in parallel, and we won't go into it. Apply this basic principle to extending the range of existing current meters, which are in the ball park area. Sometimes the only meter we can get is something which reads 50 microamperes full scale, and we want a meter to read 250 milliamperes. You can use the simple shunt technique, but you may have to stay around until your hair gets gray waiting for the meter to make a reading, since shunting meters with low resistance always slows down their response time, or the time they take to read . . . The trick here is to use a combination of shunt and series or multiplier resistances. You can almost always find a value of series, which can be used with a shunt as shown in Fig. 3, which will allow the meter to read the range you want, and with reasonable response time.

Calibrating these home converted meters is easy if you have a good multimeter. Just use it in series for current calibration, and in parallel for voltage measurements. For playing around with series parallel units to get response time, as well as desired ranges, pots, or decade boxes will do the job. Don't try to get the meters super-accurate, ball park figures are usually good enough for ham purposes. For some ranges you will have to wind your own shunts; these should generally not be of copper wire. Beg, borrow or ? some resistance wire.

Pots may be used for test purposes, then measured, and replaced with fixed resistances.

. . . W8BPY

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The EHS Portable Dipole 80 thru 6

Several years ago the Elkhart High School Amateur Radio Club became interested in a portable dipole which could be used during emergencies and Field Day. It was decided that the antenna must meet the following specifications:

1. The antennas must be fed with either 72 ohm or 52 ohm coax.
2. It must be capable of operation on all bands from 80 meters through 6 meters.
3. It must be adjustable for an SWR of at least 1.2 to one at any desired frequency on any of the bands 80 thru 6.
4. The antenna system must be simple and most important the cost should be low.
5. The entire antenna system must be small enough to be easily carried in a pocket or the glove compartment of a car.

After many hours of searching through past issues of CQ, QST, and several ARRL publications (73 magazine was only several months old then) it was decided that we would have to come up with something new since none of the antennas would measure up to our five specifications. Traps are hard to adjust. Multi-wires are a mess to work with and commercial antennas are too expensive and too large for most of our pockets.

While looking through one of the local hardware stores we were able to locate a metal chalk line dispenser which is used by carpenters to make chalk lines on floors. We removed the chalk line and noted that we could replace the chalk line with small diameter wire. We bought two of the chalk line units and loaded each of them up with 100 feet of wire (say you want to broadcast on 2.34 Mc).

A quick check of the system on 21 Mc with the antenna ten feet off of the ground indicated an SWR of less than 1.3 to one with a hank of 72 ohm coax.

Construction

Go down to your local hardware store and buy two chalk line units which will hold about 100 feet of wire on each spool. You will probably have to open up the units to see what capacity the spools have since several of the units were found to have large diameter spools and would not have been able to store the proper amount of wire. We were able to find a chalk line unit which stored the proper amount of wire and had the added bonus of having a built in lock which will keep the wire on the spool when the antenna is erected. (Evans Chalk Line, CL-50, Elizabeth, N.J.)

Remove the chalk line and attach 100 feet of number 18 solid wire to the spool. There is some reason to believe that stranded wire might go on the spool easier but we have experienced practically no difficulity with the solid wire.

The other ends of the wire are connected to an SO-239 coax connector or insulator.

A hole is drilled through the end of each of the chalk line units and a loop of insulated wire is attached. This loop serves as the end insulator for the dipole.

It should be noted that insulated wire *must not* be used with these units since proper operation of the antenna can only be obtained when the wire automatically shorts out on the spool. Otherwise you will end up with a loading coil at the ends of the dipole. The loaded spools in the chalk line units contribute to the "end effect" and we found that our antennas had to be shorter than the calculated value $L = \frac{468}{Fmc}$. We found this to vary from two to eight percent with the greatest variation coming at the higher frequencies.

It is a rather simple matter to adjust the portable antenna to any desired frequency with an SWR meter. Different colors of paint can be put on the wire for each selected frequency so that further measuring need not be made in case of emergency operation.

This antenna works 80 through 6 meters and easily fits in two pockets. It is readily adjusted to any spot frequency with a low SWR. As an emergency antenna it is very hard to beat. If the antenna is used in damp weather it would probaby be wise to wrap the chalk line units in Saran Wrap to prevent rust damage.

. . . W9FQN

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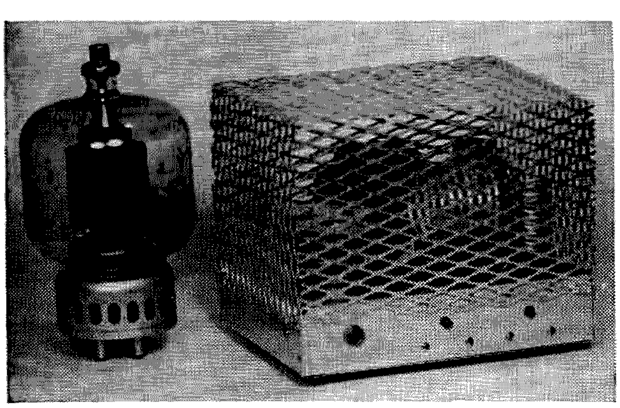
A 8072 linear with many interesting ideas for the SSB ham who wants to step up to higher power.

Some Notes on Grounded-Grid Linear Amplifiers

I have been doodling on a scratch pad over the design of a miniaturized 2 KW pep linear amplifier for quite some time. Miniaturization seems to be the order of the day and 2 KW is a practical limit for an amateur band linear amplifier. A voice average KW can be run with a little ALC or audio compression. About 600 w on the average voice is the best that can be done without it and hold within these peak limits.

This is not intended as a construction article. The amateur with reasonable experience could duplicate the linear amplifier down to the last nut and bolt by looking at the accompanying photos. A self-addressed stamped envelope along with any queries to me might even bring some help. This article is intended to bring out a tube application and some circuit ideas for grounded-grid linear amplifiers



The 8072 Amplifier compared to a 4-1000A.

that the technical minded amateur might like to include in his own amplifier. The amplifie as shown is experimental to try out the tubes It is used only for single band unattendec operation. No adjustment is necessary ove the top 100 kc of the 14 mc band so there are no dials to twiddle, no meters to watcl and no on the air "hellooooo test" necessar once it is set up.

The tubes were the big miniaturizatio problem. Jo Jennings W6EI has long sinc taken care of the tank condenser problem with his small vacuum capacitors. The tanl coil, well it has not progressed any since wound them up for my first "TNT" in th early thirties. The ultimate of simplificatio is a hi-mu "zero bias" cathode type triod used in a grounded-grid circuit. According t my research, there seemed to be no tube t fit this requirement. The RCA type 8072, 812 and 8122 series came along that could b turned into "simulated hi-mu triodes". Othe more common types have no cathode or car not be hi-mu triode operated due to the lo grid current ratings. The RCA tubes mer tioned have a CCS rating of 100 ma of gri current which qualifies them for the applica tion. All of the three tubes have the sam electrical characteristics. The difference in th plate dissipation ratings is due to the coolin and the maximum rating is 400 w CCS, n the "ICAS" rating that the amateur is use to. I chose the type 8072 as it fit the miniatu

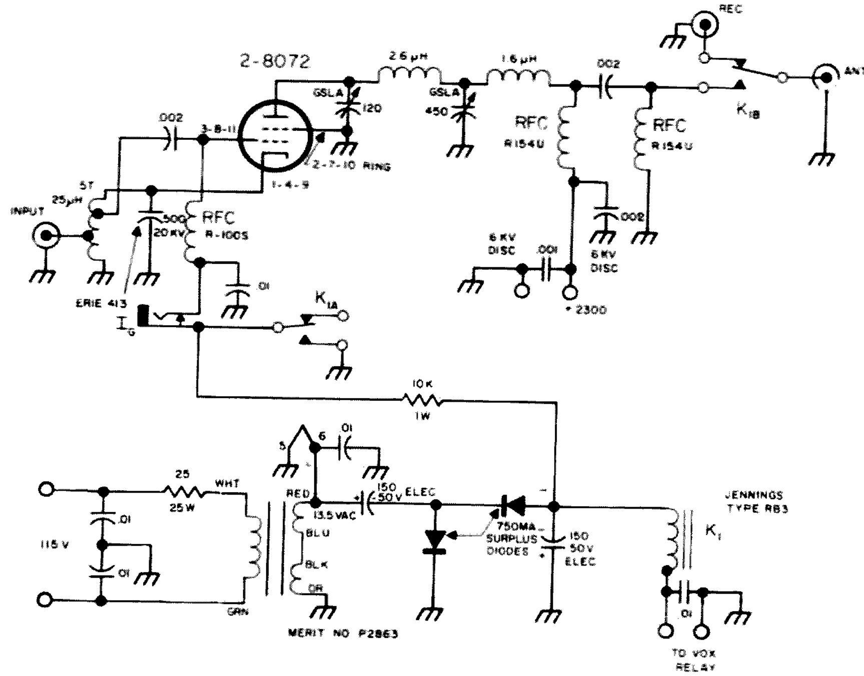


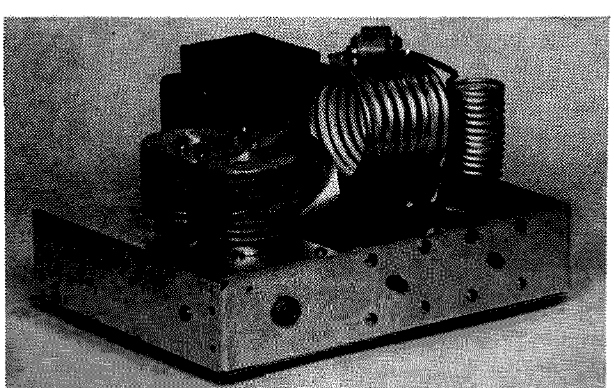
Fig. 1. Grounded-grid Linear Amplifier using 2 8072's.

zation application better though the nominal :ating is only 100 w and it is the least expen- ;ive of the series!

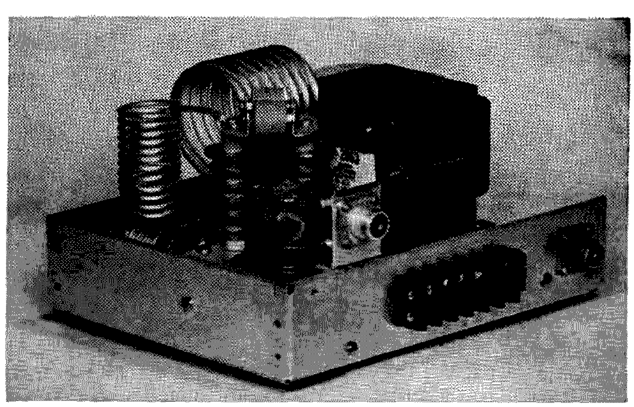
It is possible to reduce the size of the am- ›lifier down to a 7" × 9" chassis. The heat lissipation requirement could not be reduced. \ study of the photos will show the over-sized ıeat sinks that were turned out and installed o handle the plate dissipation by circulation :ooling. It will also be noted that the base ocket is recessed so that the screen ring seats irmly on the chassis. This turns the chassis nto a heat sink for the base of the tube. ıdequate circulation cooling for the duty :ycle involved with a SSB linear in amateur ervice is obtained from a 4" fan placed next o the tubes just outside the wide mesh pro- ɜctive screen.

The type 8122 was not considered as re- uired blower and air chimneys would have oubled the size of the amplifier. Some people lso object to blower noise. Having a remov- able heat sink, one does not have to buy new ones when the tubes are replaced, not a small item in tube costs. 72% in this case.

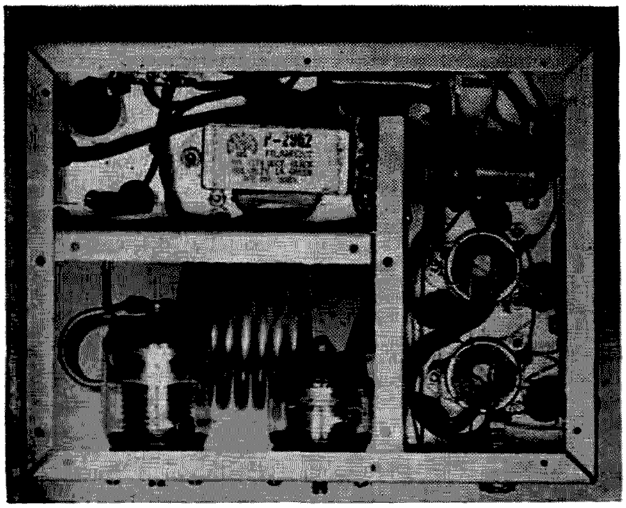
The input circuit shown is not particularly new but it does not seem to be too widely used either by the commercial or home-brew amateur band linear amplifier builders. The hi-C circuit from the cathode to ground gives a short direct path for the circulating rf cur- rent. If this is not provided, the current path is projected back to the driver tank load cir- cuit. This can cause instability in the ampli- fier as well as making the driver hard to load. If the driver and final are together on the same chassis, one properly designed tank cir- cuit will do very well. The usual set-up is for a separate exciter and amplifier where it takes a low impedance path from the cath- ode (or filament as the case may be) to ground to tie things down. The same LC ra- tio as shown for the input tank circuit has been used on all bands with good results. The in-



Front view of amplifier.



Back view of amplifier.



Bottom view of 8072 amplifier.

put tank is tuned for the center of the band by an indication of peak grid current when it is installed and needs no further adjustment.

Varying the spacing of the coil turns simplified things in the amplifier shown. A variable condenser can also be used. Preliminary calculations showed that the amplifier input impedance would not match the usual 52 ohm exciter output impedance. Experimentally the excitation was tapped up from ground to a point where the SWR approached 1:1, which worked out to be a center-tap on the coil. The grid tap on the input coil can also be calculated to equalize the grid and screen currents, but it provided only a starting point. The grid is closer to the cathode and when tied to ground with the screen, the grid current is much higher than the screen current and may exceed the plate current! The calculated point for the grid tap where the grid and screen currents would be equal is about 8.3% of the way down the coil from the cathode. The grid current at this point was well below the 200 ma rating of the two tubes and the amplifier was hard to drive. The tap was placed at one turn from the cathode end which raised the single-tone grid current to a little over 200 ma and brought the drive down to the range of the 100 w exciter. I have heard that distortion checks have been made on grounded-grid amplifiers and no improvement was noted with a tuned input circuit installed, so it was left out. This has never been checked here, but the results would depend on the test set-up. I have always included a low impedance input tank in grounded-grid circuits after having had a pair of 813's "take off" in an amplifier a number of years ago and ending up having to neutralize them.

The plate tank circuit is a little unconventional for ham equipment in that it is series fed rather than the parallel feed usually used. This eliminates the need of a high current plate blocking condenser and the rf choke is across the 52 ohm load, reducing the strain on it. The usual resistor-choke parasitic suppressor was not needed and the plate-to-tank lead is a 1½" wide flexible copper strap which really ties the two together. A pi-L tank circuit configuration was used as it reduced the size of the loading capacitor to an available capacity. Since a lead had to be connected to the pi section anyway it might as well be coiled up into enough inductance to attenuate the 2nd harmonic the 15 db that this configuration is supposed to give.

The transfer relays need not be the rather expensive Jennings vacuum relays used. There are a number of small relays on the market that can be built into the linear amplifiers that would eliminate the expensive (count all the fittings too), bulky and clacking coaxial relays on the wall or on the back of the amplifier. I never could quite understand why this was not done but then maybe everybody but me owns stock in a coaxial relay company! There is nothing coaxial inside of the amplifier so no discontinuities will occur. In this particular application the extra contacts came in handy to apply a blocking bias. The static Ip is about 120 ma with 2300 v on the plates. The -40 v (no load) bias in standby drops the Ip to about 40 ma which lowers the static dissipation and helps with the cooling.

The filament transformer used is the only one that could be found available. It is rated at a higher current than required which made the filament voltage a volt too high. This required the series 25 ohm resistor in the primary which would not be needed if a 13.5 v under load filament transformer can be found.

The adjustment of this linear amplifier or any linear amplifier is quite simple with a 'scope and envelop detector to produce a trapezoid pattern when a two-tone test signal is used. There are probably other methods of tuning up linears, judging from the carrier and "hello test" one hears on the air, but I do not know of any good ones. A dummy load is connected to the output and the load condenser is set near the high capacity end. Feed in enough two-tone signal to produce 200-250 ma of plate current. Tune the tank input condenser for resonance or maximum rf output as indicated on the 'scope or meter on the dummy load. Now turn up the gain momentarily to 550 ma and see if there are nice clean peaks on the 'scope pattern

Ꞷeep decreasing the output or load capacitor .nd repeaking the input or tuning capacitor ıntil the peaks start to flatten at the 550 ma ›oint then back off until they just do not. The ›oint is rather sharp. A few per cent change ı the load capacitor will make the difference whether there is flat-topping or not. When la-er checking with the antenna it would be ›est to rotate the beam 360° and set the load-ıg at a point where there is no flat-topping t any point in the rotation in case there is ny load variation. Now remove the tone gen-rator, plug in the mike and set the gain to ılk-up to about 400 ma or a voice average :W. The peaks on the 'scope will still be of he same amplitude so there is still "2 KW pep ıput". Do not worry if the 'micro-match' on-/ averages a couple of hundred watts or so s it won't follow the peaks up to 1200 w r so, but they are there. In case somebody hecks my math, they will find 1800 w pep nd 900 w voice average input was used. 'his allows for the driver power input which dds to the amplifier input in series and the ›tal must be no more than 1000 w. Most of ıe drive power is fed through the amplifier nd adds to the output power. I once worked chap that said since he bought a KW trans-ıitter he wanted to see it indicated on the output meter. I am glad that I did not live next door!

The above tuning procedure can be applied to any amplifier at any power level. There was no curvature on the 'scope pattern so it was concluded the tubes have good linear characteristics connected as hi-mu triodes. The exciter that was used to drive the amplifier under test had 3rd harmonic distortion down 30 db. It was still 30 db on the spectrum analyzer, out of the amplifier. That is a usable figure so the tests were concluded.

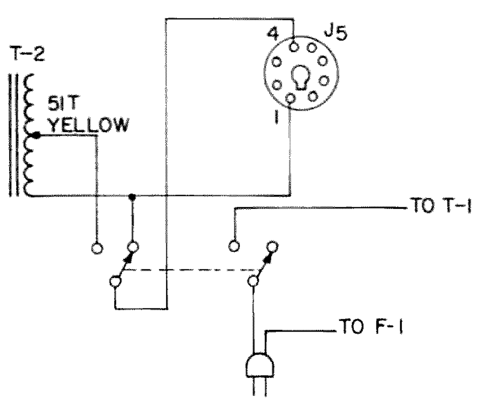
Prior to the final modification there was an input cut out relay in the circuit as shown in the underside photo. A switch turned ON in series with the VOX relay line at the control position allows a 10 db boost of the signal over the 100 w exciter. Leaving it OFF if it is not needed complies with good operating practice as well as the letter of the law. As shown in the final form any desired power reduction can be obtained by turning down the microphone gain control which can be calibrated in db.

Thanks for the helpful suggestions that guided the application of the RCA 8072 tubes goes to Mr. H. C. Vance, K2FF, Manager, Sales Engineering of the RCA Tube Division.

. . . K4ZZV

Eico 720-730

The article in the March, 1963, issue of 73 on the mode switch for the Eico 720-730 led me to do a little thinking. It seemed to me that the job could be done without extra wires leading between the units. The resulting modification is shown here. It has several advantages over the WØDSU scheme. First, the plate supply switch, S-2, may be left intact. Second, one switch is used to turn on the ac to the 730 and select AM or CW. Last, no external wires are needed. The existing wiring between J-5 on the modulator and the transmitter do the job.



Modifications to 720 and 730.

The only part needed for this modification is a dpdt switch to replace S-1 in the original 730. A two lug terminal strip is nice, but not necessary. First remove the original ac switch S-1. Replace it with a dpdt switch and reconnect the wires removed from S-1 so that when the new switch is in the on position, ac is provided to the modulator. Next disconnect the yellow modulation transformer lead from pin 4 of octal socket J-5. At this time I replaced the single lug terminal strip TB-5 with a two lug strip, using one lug as before and connecting the yellow lead to the other. This step can be eliminated, however, and a wire spliced directly to the yellow lead. In any event the yellow modulation transformer lead is wired to the dpdt switch on the *on* side of the switch. Wire pin 1 of J-5 to the *off* side and pin 4 of J-5 to the common lug of the switch and the modification is complete.

Now when the switch is off, the secondary of the modulation transformer T-2 is bypassed for transmitter B+. When the switch is on, ac is provided to the modulator and the secondary of the modulation transformer is placed in the transmitter B+ circuit.

. . . WA4DQS

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Simplified Solid State

Transistor circuitry is really simple. It is not as complicated as vacuum tube circuitry for most applications. The purpose of this article is to show just how easy it is to design and build transistorized ham equipment.

For most rf equipment, the first thing that is needed is an oscillator. The overtone crystal oscillator is the easiest, cheapest and most practical way of generating stable rf signals in the VHF spectrum. The basic circuit is shown

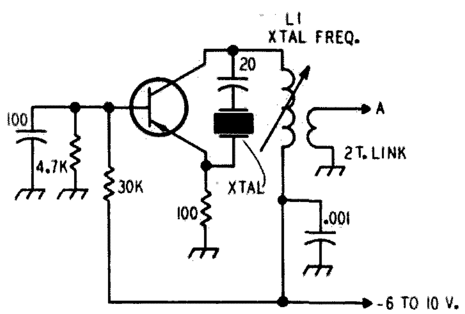

Fig. 1. Overtone oscillator.

in Fig. 1. The transistor can be any VHF oscillator type, such as the RT82, 2N1744, etc. The crystal is a third overtone type. L1 is a slug tuned coil tuned to the crystal frequency. A link of two or three turns of wire is wound over the coil for coupling to the next stage. This is the basic oscillator for VHF transmitters and converters. It is stable and just about idiot-proof. L1 is tuned to the xtal frequency to make it oscillate.

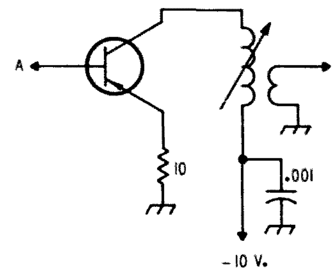

Fig. 2. Class C amplifier or buffer.

For a transmitter, the next thing needed is a final, buffer, or frequency multiplier, depending upon the application. Just about the simplest transistor circuit that exists is the class C amplifier shown in Fig. 2. The emitter resistor can be omitted. Depending upon whether it will be used for a buffer, a final, or a frequency multiplier, the tuned circuit is tuned to either the input frequency or a multiple of the input frequency. It is hard to get drive for future stages if the frequency is

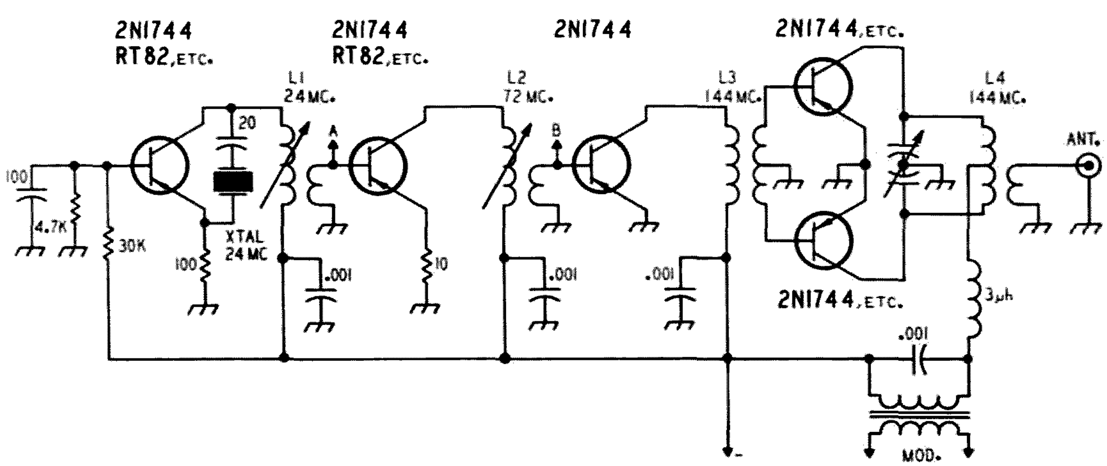

Fig. 3. Two meter transmitter.

being multiplied more than three times, so limit the frequency multipliers to triplers. The stage is biased beyond cutoff with no drive, so no additional protective bias is needed. Excitation is measured by collector current.

Fig. 3 shows a possible application of the previous circuits combined to form a two meter transmitter. It is a perfect example of solid tate simplicity.

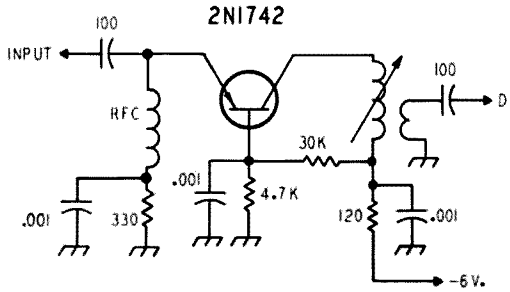

Fig. 4. Grounded base rf amplifier.

Converters are also simple. **Fig. 4** shows a grounded base rf amplifier. The rf choke and coil are chosen for the frequency being amplified. One or more of these rf stages may be used before the mixer.

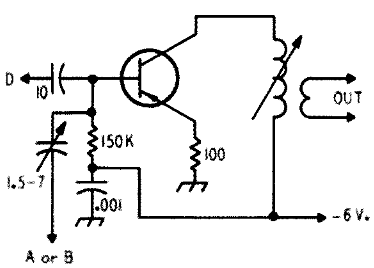

Fig. 5. Mixer.

The mixer is shown in **Fig. 5.** Point D is connected to the preceeding rf stage. Point *a* or *b* goes to either an oscillator or a frequency multiplier chain as shown in **Fig. 1, 2** and **3.** The output can either go to a receiver or to another mixer for multiple conversion. These circuits are good up to about 250 or 300 mc. The values shown are typical values, although they may have to be changed slightly to get optimum performance from particular transistors.

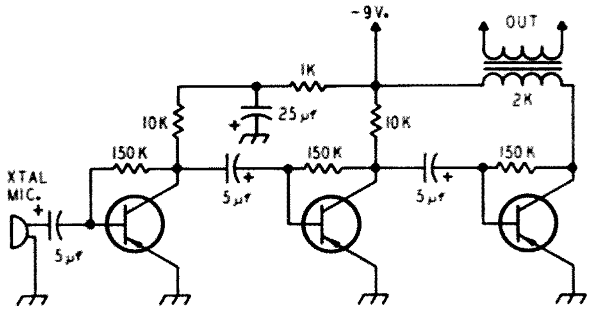

Fig. 6. Audio amplifier and modulator.

Fig. 6 shows a general purpose audio amplifier that can be used as a speech amp, a low power modulator, or an audio monitor amp for a receiver. The transistors are general purpose PNP audio types, available for a few cents. The secondary impedance of the transformer is chosen for the application.

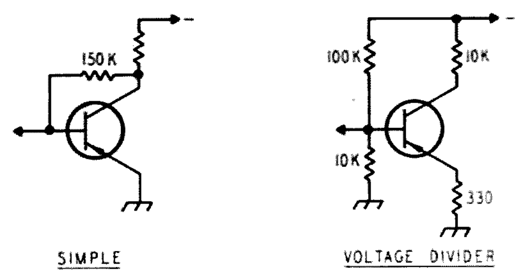

Fig. 7. Biasing methods.

Fig. 7 shows two possible methods of biasing a class A amplifier. The first is the simple bias resistor method, which is cheap and easy, although it does not have the dc and thermal stability of the second method. For audio amplifiers, etc., the first is adequate. For rf amplifiers, the second is preferable.

The above should be a useful outline for designing transistorized equipment. While it does not go into all the possible circuits or applications, or go into any great detail, it should provide a starting point for design work. When values are given, they are only typical values, to be used as a starting point in trying to optimize any design. I hope that this will be of value or at least give you a few ideas when you decide to design some solid state gear. . . . WA2INM/1

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All-Band Tuning for the Drake 2B?

When I read WN4QGQ's item in November 73 about the use of the crystals supplied with the Drake 2-B to obtain band segments not originally intended, I was reminded of a similar article that appeared in the July '62 issue of QST. The crystal switching approach strikes me as a lot of monkeyshines for so little benefit if it is only desired to have a "look" elsewhere to see what is there. It occurred to me that since an LC circuit is used in non-crystal oscillators to determine the frequency, a variable LC circuit might replace accessory crystals in the 2-B, permitting all-band coverage.

Picking up the closest likely looking coil and capacitor from the junk box (19 turns B&W 3004 and a National 100 pf transmitting variable), I was pleasantly surprised to find that the combination would tune from about 8 to 27 mc. Adding about 18" of RG-58/U loused that up until I inserted a 33 pf disc ceramic in series with the center conductor. I still could not get above about 21 mc. I attached the other end of the coax to a piece of surplus circuit board, cut down to about ¾" × 1", as shown in Fig. 1. Of course the copper conductors were peeled off first, and then the holes drilled to support the wires. I used resistor trimmings (tinned #18) for the pins.

With the circuit tuned to 12 mc, I was able to copy both sides of a CB ragchew between a local and one about 30 miles from here. The preselector was at about 9¼, and it was the E position, I believe. This indicated to me that there is sufficient second harmonic energy to replace overtone rocks in this manner.

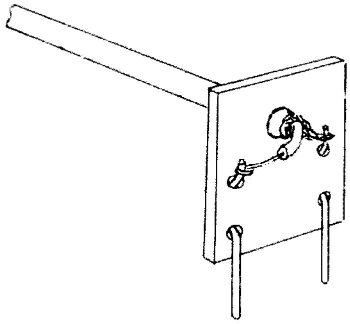

Fig 1. Single dummy crystal.

Of course it is natural to picture ganging the crystal sockets together (as the selector picks one position at a time) and using a single calibrated LC combination to give the full coverage desired. Just add (or subtract) the 3.5 to 4.1 mc *if* (I find 3.8 mc to band center easier) to the LC frequency. This could even be taken into account when calibrating.

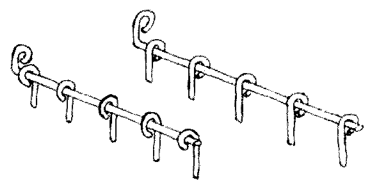

Fig. 2. Buss crystal connections.

You can imagine my chagrin when I couldn't repeat. Somehow a local 80 meter station kept popping up where I didn't want him. Was the coil acting as an antenna? I du up a cabinet to enclose my little jewel. It still didn't work. In checking the Drake schematic, I learned that the "E" position is not connecte as are the other 4, so I cut off the pins to th "E" socket. And it still wouldn't seem to wor again. I removed my bus conductors from th crystal sockets, and tried the single dumm again. No better. That local on 80 was still i there pitching. So I switched to 80 and yakked a while.

While playing with this thing, I found tha I could inject the grid-dipper oscillator frequency into the receiver through this combination, and come up with new band segments Then in trying to rig up a transistor oscillato (on the same LC combination) I couldn't ge it to take off.

But rather than let this project suffer th fate that seems to have befallen about 20 othe projects that are in various stages of progress(?) in my shop, I felt that maybe someone who knows more about what he is doin would like to take it from here. Be my guest.

. . . K9LTD

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When Standard Switches Won't Fit

Modification and updating of equipment almost invariably calls for addition of functions, which need more controls than were originally supplied with the equipment. In most instances, the panel does not have enough room for the added controls, and space inside the chassis is not too plentiful.

Back in the days when one Shicklgruber was still a struggling artist about one third of this problem was solved by the manufacturers of potentiometers, who attached a switch to their product, so that when the audio volume was turned full off (CCW), the switch opened. Combined potentiometers and switches are used on a wide variety of electronic devices, from your wife's "kitchen radio" to the GPR-90 you wish you could afford.

With the coming of the TV boom dual controls with concentric shafts were introduced. These range in quality from the mechanical abortions used on cheap TV sets to the beautifully-built and smoothly-working dual controls used on Tektronix oscilloscopes, and other items of premium equipment. In many instances, already-made dual concentric controls will solve your specific problem, with a minimum of labor and a minimum of cost. Check a good controls catalog before deciding to build a special control.

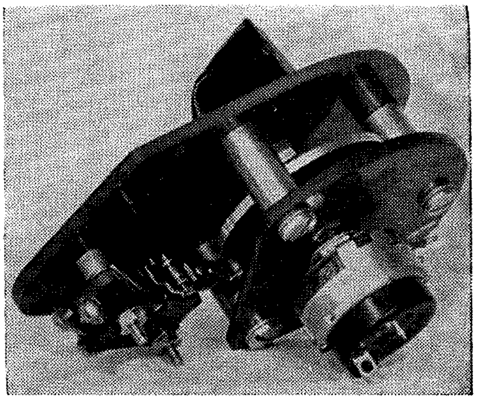
In some instances, however, no available commercially-made control will do the job, and something must be made to fit the special need. Even here, use of standard components will save a great deal of time and work, and will facilitate eventual repair and replacement.

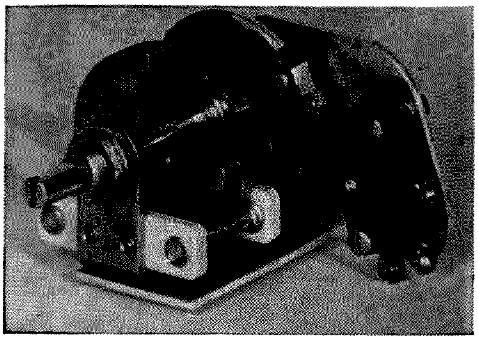
Experience with a wide variety of special switching devices shows that most of them can be constructed from available standard components, without any very complex machine work, and that most of them can be made to work very well indeed. A little patience and ingenuity are a great help in designing such special switches; and a few minutes spent in lining up the components, after assembly, and before installation, will save many hours of "diddling" at a later date.

. . . Ives

1

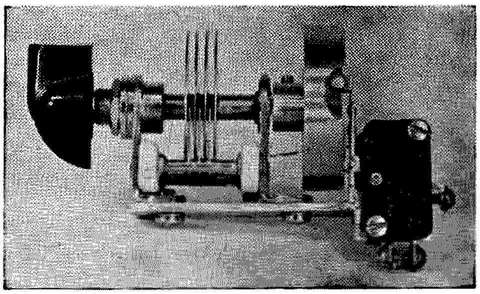
When additional switching is needed with a potentiometer, beyond that obtainable with an available "attachable" switch, a switch-actuating cam can usually be mounted on the front shaft extension (which is commonly about 2″ long), and this can be made to operate one or more Microswitches. Such a special switched control is shown in Fig. 1. Here, the Ohmite pot (type CU) with its attached switch (type CS-1) is mounted on a small bakelite sub-panel. The cam actuator, a gear with its teeth turned off, and an operating notch filed in, is then placed on the shaft. In front of this, and separated from the rear sub panel by brass spacers is a second sub-panel large enough to support a Microswitch with a roller actuator. Bearing for the outer end of the pot shaft, and ferrule for mounting the assembly on the main panel, is provided by a conventional panel bearing (Johnson 115-255).





When a switch must be actuated by a capacitor shaft, the same technique can be used when the shaft length is adequate. In most instances, a capacitor with sufficient front shaft extension will not be available, and a capacitor with a rear shaft extension should be chosen. Actuating cam is attached to the rear shaft extension, and the microswitch is supported by a small aluminum or brass bracket as in Fig. 2.

2



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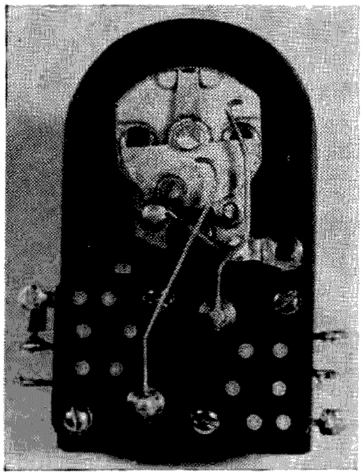
Where side clearance is inadequate, the flat cam can be replaced by a cup cam (turned on a lathe), and the microswitch mounted in back of the capacitor, as in Fig. 3. As with the pot, more than one Microswitch can be operated by a single cam; and multiple cams can be used if necessary, although the capacitor bearings are not usually suited for large external mechanical loads.

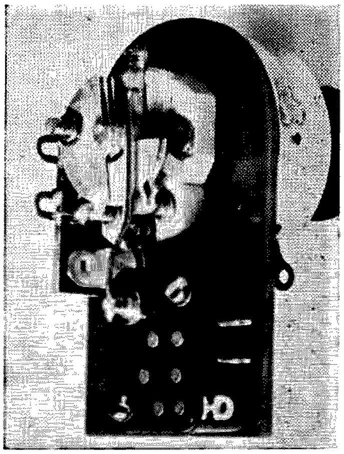


With very small capacitors, such as the familiar APC types, neither front nor rear shaft is suitable for mounting a cam. With these, however, if the rotor is grounded (usual case), a stud can be soldered to the rear rotor plate, and this can actuate the extension wire of a type V-4 Microswitch, originally made for use in coin-operated equipment. Ordinary paper clips make good extension wires. An example of switch operation with an APC capacitor is shown in Fig. 4. Here, one switch turns on the BFO, which is tunable through 180 degrees of the capacitor shaft rotation. Further rotation of the shaft, beyond 180 degrees, actuates the second switch, which turns off the tunable BFO and turns on a crystal BFO. Returning the shaft to zero position (counterclockwise) turns everything off. Although the V-4 Microswitch, with its wire actuation, appears quite fragile, the illustrated assembly lasted for nine years of service with no maintenance whatsoever. It was taken out of service only because the related equipment became obsolete.

4

5

Another special switched control, this time using a dual concentric shaft, is shown in Fig. 5. This combination includes a switch, a capacitor, and a potentiometer. The switch is actuated by a stud on the rear rotor plate of the capacitor, and is controlled by the inner shaft (BFO tuning and off-on). The potentiometer is controlled by the outer (hollow) shaft (BFO injection). No special problems are encountered here, but care must be taken to align all the components exactly, so that the controls work smoothly, and have a correct "feel".



A CHU Time Receiver

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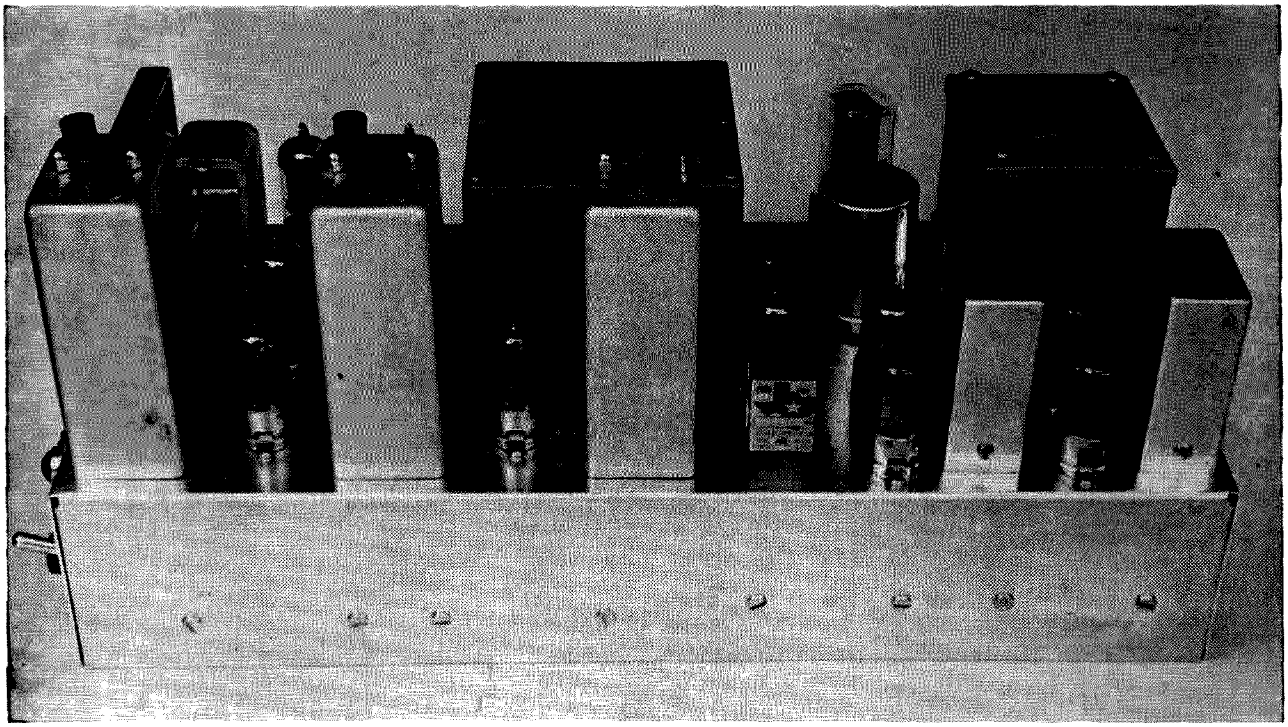
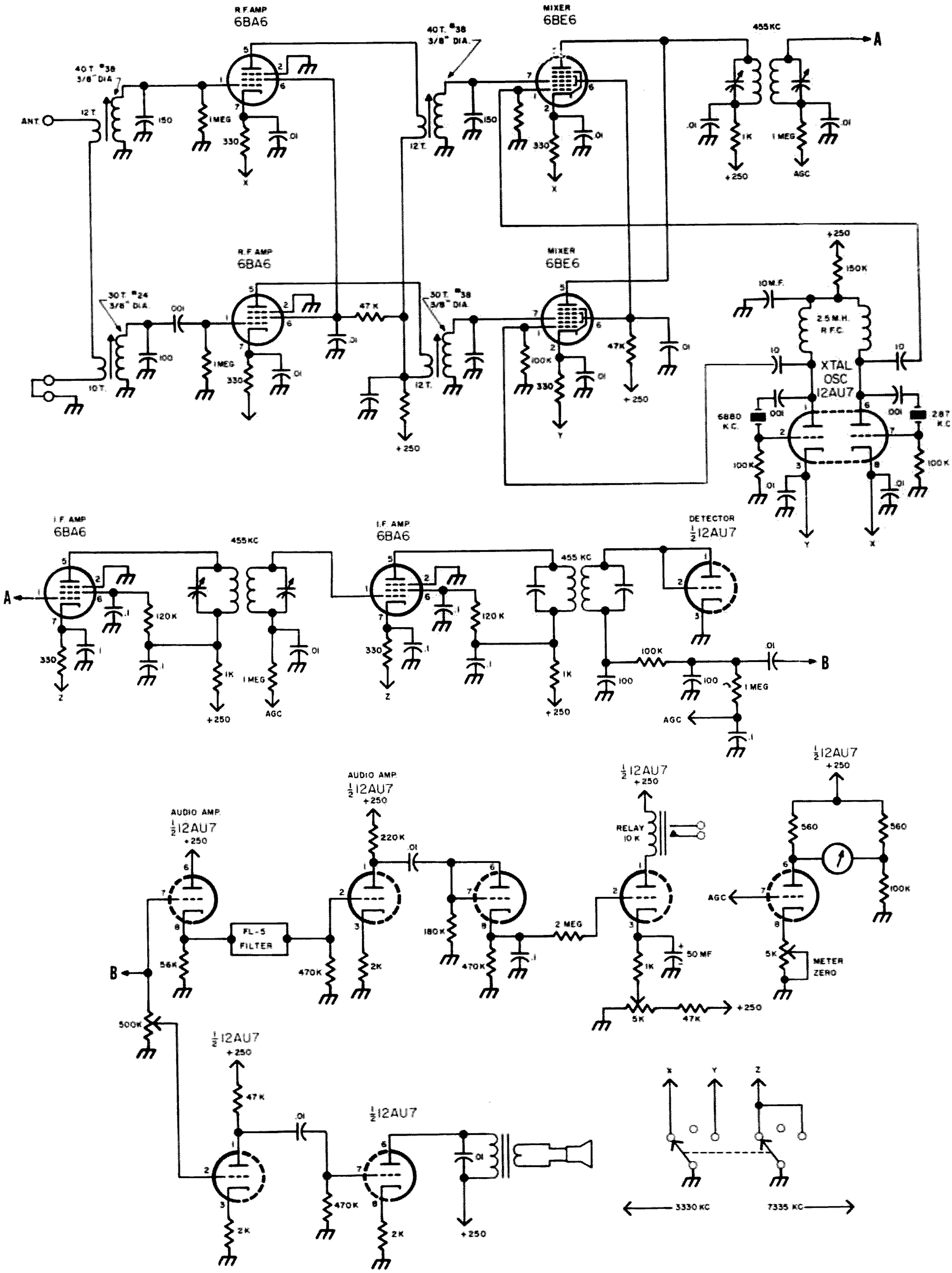
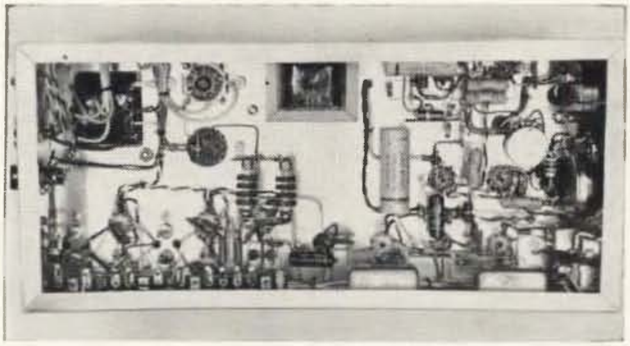
Radio station CHU, of the Dominion Observatory, Canada, broadcasts some very useful time signals on 3330, 7335, and 14670 kc. While anybody can use these signals for setting his watch, all of you hams who also have amateur astronomy for a hobby can do more with them if you have a receiver like the one described here. The set is crystal-controlled, to receive CHU on 3330 and 7335 kc, which happen to be the best frequencies at this QTH.



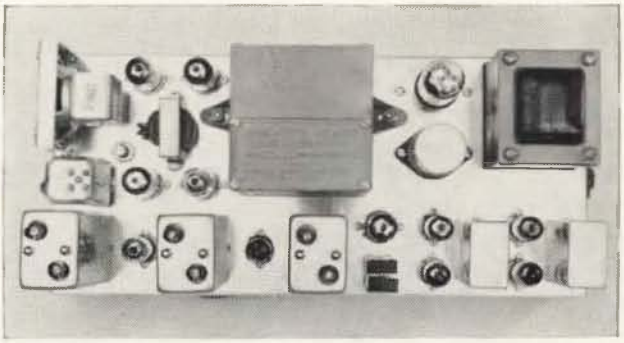
Side view of the CHU Receiver.



Schematic of CHU Receiver.



Bottom view.



Top view.

The time signals operate a relay in the receiver, which keys one pen of a two-pen recorder. The other pen is keyed by the local clock, through a photo-cell system which looks at the pendulum. This allows precise measurement of the clock rate, and either pen can be switched to a remote location for recording transit sightings against either the clock or CHU.

A separate rf amplifier, mixer, and crystal oscillator is used for each of the two frequencies, as this is simpler than switching the rf circuits, and allows the use of a regular toggle switch in the cathodes for selecting either frequency. The mixers feed a two-stage 455 kc *if* amplifier. A diode detector furnishes agc voltage, which controls the gain of the rf and *if* stages. A two-stage audio amplifier drives the small built-in speaker. The time signals consist of voice announcements every minute, and 1000-cycle tone beeps at one second intervals. These tone signals are filtered through a FL-5 range filter, which does an excellent job, even though it is centered on 1020 cycles. The filter output is amplified, rectified, and the resulting dc voltage used to control the relay tube. A meter circuit is included to indicate relative signal strength, and for peaking the rf and *if* circuits.

I will be glad to answer any letters from anyone who desires further information on the receiver.

. . . W2LYH

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Switching with Diodes

Many hams tend to think of the semiconductor diode only in terms of its use as a rectifier. This is understandable because the use of semiconductor diodes in much of the commercially manufactured ham gear is restricted to rectifying applications in power supplies, detector circuits, balanced modulators and clippers. In properly designed circuits, however, the diode may also function as a highly efficient and reliable non-rectifying switch. Diode switches may frequently be used to replace the conventional mechanical switch in ham communications equipment while offering a significant advantage in reduced size and cost and increased design flexibility and dependability. Before discussing practical switching circuits and associated design considerations, it might be helpful to briefly review the basic principles of solid state physics necessary for an understanding of the theory of semiconductor diode operation.

The basic materials currently being used in semiconductor manufacture are elements from Group IV on the chemical periodic chart, usually either silicon (Si) or germanium (Ge). The Group IV elements each have four bonding electrons (valence electrons) and in their pure, solid state are characterized by the formation of the tetrahedral crystal lattice. In the tetrahedral crystal lattice each atom is pictured as being at the center of a tetrahedron surrounded by four like atoms at the vertices of the tetrahedron. (See Fig. 1).

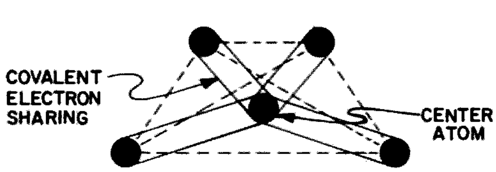


Fig. 1

Each atom in the lattice except those on the outside surfaces forms four covalent bonds by sharing one electron with each of the four adjacent atoms. This effectively results in giving each atom the highly stable octet arrangement of electrons in its outer shell. Thus all available electrons in the crystal lattice of the pure element are used in forming rigid covalent bonds and under normal conditions cannot be excited into the higher energy "conductive bands" for the conduction of electric currents. As a result, pure silicon and germanium are notably poor conductors.

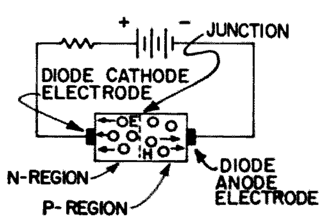


Fig. 2

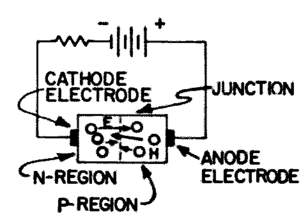
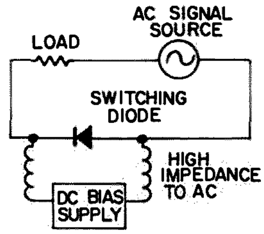


Fig. 3

The "trick" in the manufacture of semiconductors is to introduce either tri- or pentavalent "impurity atoms" into the silicon or germanium crystal lattice. In practice, certain chemical elements from Group III with only three bonding electrons or from Group V with five valence electrons are used as impurities. When a proper Group V impurity is placed into a tetrahedral silicon lattice, for instance, it is found that the impurity atom forms covalent bonds with its four adjacent atoms. However, the impurity atom has five valence electrons and only four of them are required for chemical bonding. As a result there is one electron which is "left over." Although the one unused electron for each Group V atom is electrostatically balanced out by the additional proton in the nucleus of the impurity atom, it can easily be excited into

Fig. 4



the "conductive bands" where it can migrate as an electric current when only a small voltage is applied across the semiconductor crystal. Group V impurities produce a region of "freeable" electrons which is commonly called an "N" region. On the other hand, Group III impurities in a tetrahedral lattice produce a region of "electron deficiency" known as a "P" region. It is possible for a P-region as well as an N-region to conduct electric current because both freeable electrons and electron deficiencies (called "holes") can migrate through a semiconductor crystal lattice if the proper impurity density has been established.

A semiconductor diode is manufactured by forming a junction between a piece of N-type and P-type semiconductor crystal material. Because diode switch circuits, as we will see later, operate by virtue of changing bias polarity and voltage across the switching diode, it might be helpful to quickly examine the electronic operation of reverse and forward biased diodes.

Fig. 2 shows a reversed biased diode. The "holes" in the P-region are attracted by electrostatic forces toward the negative terminal of the applied voltage, a direction away from the P-N junction. At the same time the "free electrons" in the N-region migrate away from junction towards the diode electrode which is connected to the positive battery terminal. Remembering that the basic units for voltage ("volts") are joules per elementary charge, it follows that as the reverse bias voltage is raised, the electrostatic forces acting on the carriers (ie. freeable electrons and holes) increase. Thus as the bias increases, the concentration of carriers further decreases in the regions of the N and P crystals near the P-N junction. Under normal conditions current cannot flow through the reverse biased diode because a "depletion zone" of carriers exists at the P-N junction and there is no available mechanism for a transfer of charge. Under abnormal conditions (for most purposes), the reversed biased diode may be made to conduct by raising the bias voltage to the point where "break down" occurs in the crystal with chemical decomposition and the formation of movable ions.

In a forward biased diode, the situation is reversed. See Fig. 3. Due to the bias voltage polarity difference in the forward biased diode, the carriers migrate across the P-N junction instead of away from it. This permits current to flow through the diode.

So far, we have looked at forward and reverse biased diode circuits where the bias voltage or current has remained constant with time. In practical diode switching circuits where ac voltages and currents are being switched, however, the effective values of "bias" current and voltage vary with time. Fig. 4 shows a general diagram for a diode switch circuit where the diode is being used to switch an ac signal. The switching state of the diode depends upon both the value of its steady dc bias and the instantaneous values of ac current and voltage. If the value of dc bias is zero, we recognize the circuit to be identical to that of a half-wave rectifier. In this case, rectified ac in the form of pulsating dc appears across the load. We are interested, however, in switching the ac signal without clipping or rectifying it. With proper adjustment of the value of dc bias and polarity, it is possible to make the diode function as a switch without rectifying. The graphs in Fig. 5 show how this is accomplished. In graph A, the value of fixed dc bias is periodically exceeded by peaks in the waveform of the signal which is being switched. As a result clipping takes place whenever the instantaneous bias amplitude changes polarity. The ordinate axis,

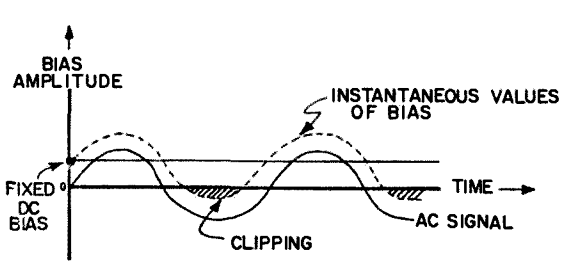


Fig. 5A

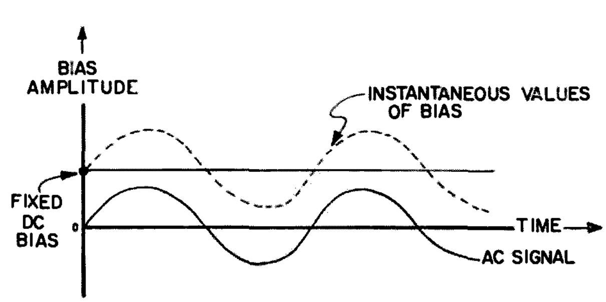
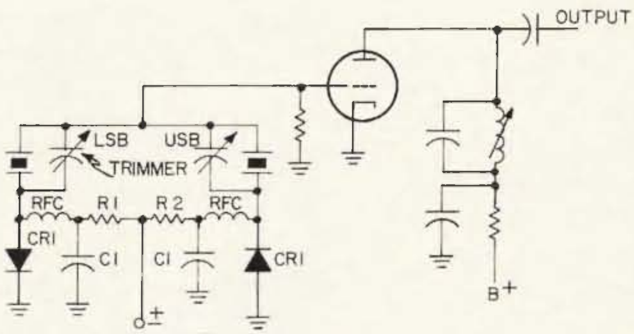


Fig. 5B



TO SWITCHING GATE VOLTAGE } + FOR LSB
− FOR USB

Fig. 6

"bias amplitude," can represent "current" in the case of the conducting ("ON") forward biased diode or "voltage" in the case of the non-conducting ("OFF") reverse biased diode. In graph B the fixed dc bias exceeds the peak values of the ac signal and as a result, the bias polarity never changes. Thus when the diode switch is on, the ac signal is passed without being rectified; when the switch is off, no ac signal appears across the load.

By now the reader has hopefully studied Fig. 4 and Fig. 5 and understands the theory of how diodes can be used as non-rectifying switches for ac signals. Therefore we will now go on and look at several practical working circuits employing semiconductor diode switching elements. Fig. 6 shows a method of using a diode switch to switch crystals in a crystal oscillator. The basic oscillator circuit shown here is similar to one used as the carrier oscillator for LSB and USB with a popular commercial sideband crystal filter. However, by using diode switches instead of a mechanical switch to switch LSB and USB crystals, an advantage is gained because it is no longer necessary to locate the carrier oscillator circuitry physically close to a front panel LSB-USB switch so that the wire leads from the crystals to the switch can be kept short. Furthermore, an rf quality LSB-USB switch is no longer required since it is only necessary to switch the diodes' bias voltage to select different crystals. Resistors R1 and R2 are selected to provide proper biasing for each diode. The rfc choke and by-pass capacitor (C1) are chosen to minimize rf voltages on the switching bias lead. Almost any diode with a high reverse—forward resistance ratio can be used for CR1. The positive and negative voltages needed for the diode switching gate lead can be selected with a single pole double throw switch from voltage dividers across the transmitter bias supply and across the transmitter B+.

Fig. 7 shows a method of using a diode

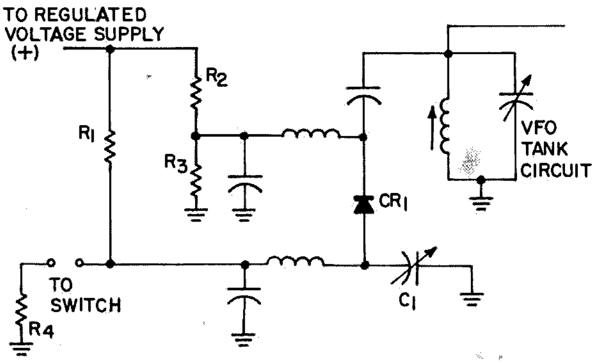
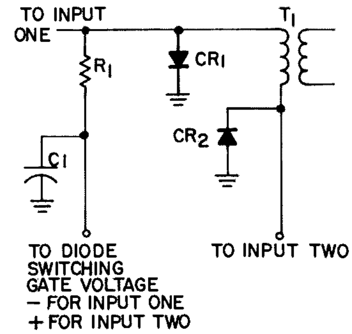


Fig. 7

Fig. 8



switch to switch a capacitor across a vfo tank circuit to produce a frequency shift. Circuits similar to this one can be used to advantage for LSB-USB vfo dial correction in SSB transmitters or for FSKing for synchronous detection or RTTY. A regulated bias voltage which can easily be obtained with a zener regulator should be used in this instance because all diodes show a change in capacitance as their reverse bias changes. The values of R1, R2, R3, and R4 should be chosen for proper diode biasing and bias polarity reversal. It might be helpful to note that the biasing arrangement used here is identical to placing the switching diode across a Wheatstone Bridge composed of R1-R4. Capacitor CI can be used to control the amount of frequency shift. Again, almost any good quality junk box diode may be used for CR1.

Fig. 8 is the diagram of a method for using diode switches to switch a transformer primary between two inputs. This circuit may readily be used for switching low level audio stages, for switching a receiver between various antennas or VHF converters, or for switching an *if* stage or a crystal filter. If transformer TI happens to be a tuned transformer, it is recommended that trimmer capacitors be placed across both CR1 and CR2 to compensate for possible differences in the capacitance of each diode. If audio is being switched, R1 and CI should be chosen to provide adequate decoupling without loading down "input #1" more than necessary. For rf or *if* stages, an rfc can be used in place of R1.

Diode switching circuits are truly "cheap and easy." In practice it is possible to use just about any diode which is in reasonably good condition. This includes everything between crystal-set detectors and high power silicon rectifiers. The only requirement on the switching diode is that it be capable of conducting "forward" currents of two or three times the signal current and capable of withstanding an inverse voltage of two or three times the signal voltage. Other than this, the main thing to remember is that the diode bias resistors should be adjusted so that the bias current through the "ON" diode is not exceeded by the signal current and that the bias voltage across the "OFF" diode is not exceeded by the signal voltage. Switching gate lead filtering is not at all critical and bias supply regulation must be used only in special instances. Diode switches are readily adaptable to hundreds of different circuits in ham equipment. Next time you need something to switch low level ac, why not use one?

. . . K1SDX

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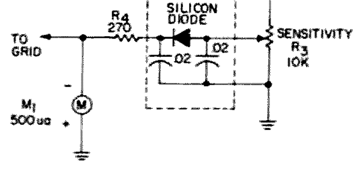
Improving the Paco GDO

I purchased the Paco G-14 grid dip meter in kit form about four months ago. I assembled it and found that it worked quite well on all but the highest frequency range (110-250 mc). There was very little indication of grid current over much of the tuning range. This was traced to a defective sensitivity control which left a small bias on the meter. When I shorted out the control I was able to get a usable reading, but now, I found so many spurious responses that the instrument was still of little use over this frequency range.

At this point it was back to the drawing board for a long look at the circuit diagram where a new problem became apparent. Even with the sensitivity control working properly the meter would be shunted with the 270 ohm resistor, R4, which would lower its sensitivity anyway. The problem was a twofold one. I had to kill the residual bias from the sensitivity control and also block the shunting action of the resistor, R4. I decided to insert a small silicon diode between the sensitivity control and R4 with its cathode towards R4. In this application I hoped to use the forward voltage drop of the diode to solve both my problems. The result far exceeded my hopes. I now obtained grid current indication varying from a low of 70 uA. to a high of 250 uA. and the sensitivity control functioned nicely. To make sure that the diode wouldn't misbehave I bypassed both sides of it to ground with .02 ceramic discs (probably unnecessary) and established a direct ground to the cover of the sensitivity control.



Partial Schematic of Paco G-15 grid dip meter. Added parts are enclosed by dotted line.

Now there were excellent meter readings but the many spurious dips throughout the tuning range left much to be desired. I examined the meter for possible clues. The most promising lay in the fact that the front end of the tuning capacitor rotor was grounded only by the ball bearings. The shaft extended through the chassis and connected to the large aluminum tuning dial. The top edge of the dial in turn was exposed to the plug in coil. I made a small wiping contact from spring brass and fastened one end under one of the condenser mounting screws. The other end was arranged to rub against the back side of the tuning dial. This proved to be the answer. There remained only a small dip at 190 mc and another small one at 250 mc. Both dips are smooth and so slight that they don't interfere with operation. Although one spring worked nicely, I placed two springs against the back of the dial and one against the capacitor shaft where it extends through the chassis.

With the electrical details corrected, I found that there remained a mechanical one. The plastic hairline indicator was threatening to wear away the graduations printed on the tuning dial. I solved this by cutting out a circular piece of thin, transparent plastic slightly smaller in diameter than the tuning dial. I clamped it between the hub and the tuning dial so that it rotates with the dial and takes the wear from the indicator.

I would also like to offer a suggestion to the manufacturer. The various coils supplied with the G-15 are very nicely color coded so that it would be much more logical and convenient to designate the corresponding bands numerically rather than alphabetically.

After making the changes outlined here, I have been very pleased with the performance of my G-15 and I hope others may do likewise. . . . K1AMN

Curing Distorted RTTY Patterns

The simplest means of tuning in a RTTY signal is with a scope. Most homebuilt converters obtain the mark and space signals directly from the toroid filters feeding the discriminator, similar to the circuit of Fig. 1. However, the main drawback in using this method is that the scope pattern is sometimes distorted as in Fig. 2-A and tuning is difficult.

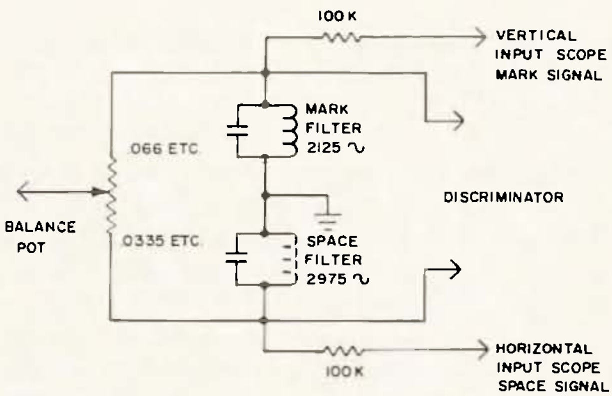


FIG 1

If the converter is working properly an FSK signal will be only slightly elliptical, as in Fig. 2-B. In tuning in a mark or space signal the patterns should be similar to Fig. 3-A and 3-B.

The distortion can often be cured by putting two 100-K resistors in series with the toroid filters feeding the vertical and horizontal input of the scope.

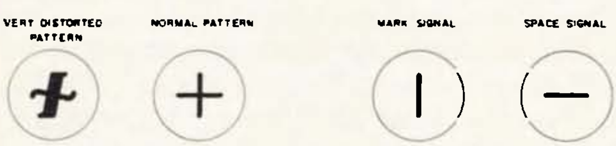


FIG. 2A FIG 2B FIG. 3A FIG 3B

Another cause can be ringing taking place somewhere in the unit as a result of poor layout of the converter. All circuits should be run in a straight line and under no condition should an input circuit be located close to its output circuit. Also—remember that aluminum is a poor shield where wiring is done close to power transformers, chokes, input transformers, and mark and space filters, so keep the low level circuits away from such hazards.

With care we can obtain the kind of performance stated in TU designs and our tuning becomes a pleasure with a clean scope pattern. BCNU on RTTY.

. . . K4GRY

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Another Way to Measure Noise Figure

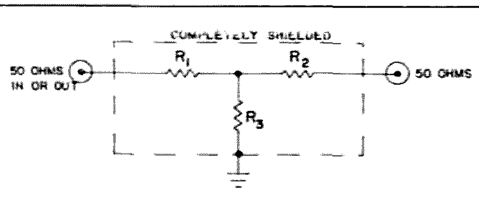
Many times it's been said, but it can always bear repeating. Noise figure is probably the least-well-known measurement in any amateur station.

At least a part of the difficulty with noise figure lies in the means usually employed to measure it. While it's not too difficult to figure out the power input to your final, or even the power *output* (often a surprisingly different figure), measurement of receiver noise figure tends to be a complicated and somewhat inaccurate process at best. It requires special equipment, and even then may be no more accurate than plus-or-minus 100 percent.

The classic means of measuring noise figure is to use a noise generator and crank in additional noise until receiver output is doubled. This means, of course, that the noise generator output is then exactly equal to the original noise, and if the noise-generator output is accurately known then the original noise is also known. All this has been gone into in detail in another article.

However, a noise generator with accurate calibration isn't so easy to come by, and an inaccurate noise generator doesn't do much good for measurement purposes (although it's fine for tune-up).

There *is* another way to do it, which is actually much more in line with amateur practice. This other way also requires some test equipment, but it might be more easy to come by.



DB Loss	R1, R2	R3
3	8.2	150
6	16	68
9	24	39
20	39	10

All resistors composition, ½ watt, 5%

Fig. 1. Construction of T-pads

Before we get into the details of the "other way" to measure noise figure, let's take another look at the reason for using noise-figure measurement as a yardstick for receiver sensitivity in the first place.

To start, we're really interested in the answer to the question "How weak a signal can I hear?" In the 3-30 mc range, the question can be answered directly—how many microvolts must the receiver have to give readable output?

As the vhf region is entered, though, the fractional microvolts become alarmingly small. Somebody figured out that most of the problem lay in the receiver's own internal noise, and came up with the idea of a "perfect" receiver which would have no noise at all. This is a noise figure of 0 db. Now by comparing existing receivers to this perfect ideal, and comparing the internal noise in db, we had a way of discussing receiver sensitivity.

Since we're now talking about noise, which is equally present at all frequencies throughout the spectrum, we can see that the amount of noise present in a receiver's output is at least partially determined by how much of the spectrum we are looking at. A broad receiver has more noise output than a narrow one, all other things being equal. If you don't believe it, fiddle with the selectivity switch on your own rig and listen to the change of noise output.

This dependence of noise on bandwidth is another reason for using noise figure as a comparison. The *actual* amount of noise is cancelled out in the comparison, leaving only the relative amounts of noise in the "perfect" receiver and the receiver under test to be measured.

When all this became established, nobody

was paying much attention to receiver bandwidth and it was felt that a true determination of the effective noise bandwidth of a receiver was much more complicated than the comparison measurement. However, in these days of SSB and special filters, that's not so true any more.

As you may have guessed by now, the "other method" of determining noise figure depends on a microvolt measurement and knowledge of the receiver's effective noise bandwidth. The only reason for converting the results back to noise figure is to allow comparison with measurements made in the more conventional manner.

With typical ham measurement techniques, the results won't be of National-Bureau-of-Standards accuracy. However, if you're reasonably careful, results using this method will be at least comparable in accuracy to those made with a homebrew noise generator. Ready? Let's go:

You'll need two items of test equipment (only one if you're really lucky). These are an rf signal generator covering the desired frequency range on fundamental output, and an rf VTVM reasonably accurate at the desired frequency. If you have access to a "microvolter" or similar laboratory signal generator, you won't need the VTVM.

In addition, you'll need a whole handful of 50 ohm T-pads; these can easily be put together in a hurry by following the schematic in Fig. 1. You'll probably need about 8 20-db pads, as well as one each in 3-db, 6-db, and 12-db values.

Turn on both the receiver and the signal generator and let them warm up. For protection against any leakage from signal-generator to receiver through the power lines, it's best to supply them from separate circuits and to use a power-line filter such as that used to eliminate rf interference between the power line and the unit.

Connect a string of six 20-db pads to the signal-generator output as shown in Fig. 2, and adjust output of the signal generator to 0.1 volt. If you have a microvolter or equivalent, use only one 20-db pad and set generator output to 1 microvolt.

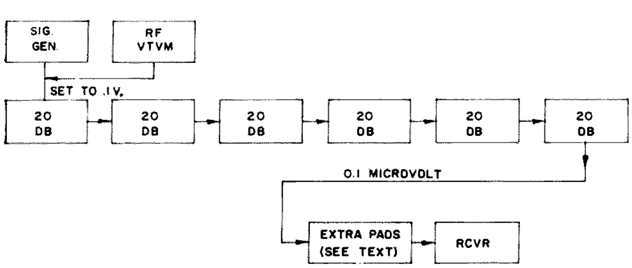


Fig. 2. Test set up.

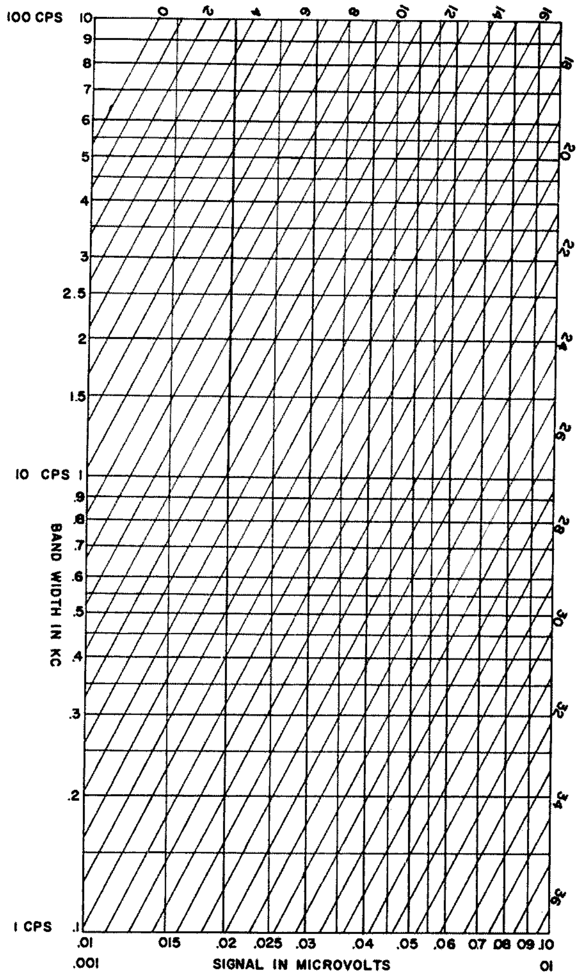


FIG. 3

Fig. 3. Noise figure vs. microvolts.

In either event, the output of the final T-pad will be a 0.1 microvolt CW signal. This should be more than adequate for any reasonably-sensitive receiver to allow spotting of the signal.

Switch the receiver's avc off and the bfo on, and place the selectivity switch in any position for which the selectivity is accurately known. The selectivity marked on the front panel will not be the effective noise bandwidth, but you can use it as a starting point to guesstimate the noise bandwidth. If your receiver uses a mechanical filter or other device with approximately the same skirt selectivity, effective noise bandwidth will be about 1½ times the bandwidth marked on the front panel. If it is one of the older types with reasonably broad skirts, noise bandwidth will be about 3 times the marked value. Both these correction factors are approximate, of course; if you have any means of measuring effective noise bandwidth, use it instead.

For a start, use a fairly broad selectivity position; this requires more signal and makes things a bit easier.

Now tune in the signal from the generator,

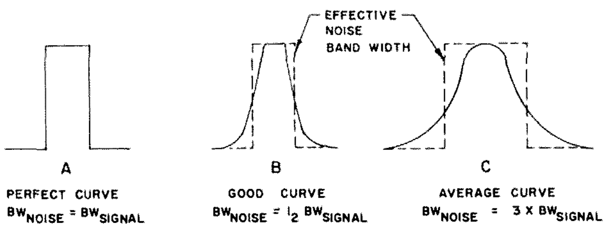


Fig. 4. Relation of noise and signal bandwidths.

leaving gain controls at maximum but tuning for maximum signal strength just as if it were the new state you need. The 0.1-microvolt signal should be easy to find.

Next step is to reduce the generator output by hooking in additional T-pads until you locate the point of "minimum discernible signal." The 3, 6, and 12 db pads may be hooked up in series in any combination to give you from 3 to 24 db additional attenuation in 3-db steps. Using another 20-db pad will give you from 20 to 44 db more attenuation, and the signal is sure to become too weak to copy before you reach 44 db below one-tenth of a microvolt!

The point of MDS is approximately equal to a 0-db signal-to-noise ratio for most of us, and is considerably easier to determine than would be a true output S/N ratio. When you find this point, record the db below 0.1 microvolt and the selectivity (in kilocycles) used.

Now switch to a different bandwidth on the receiver and repeat the test. Record its results also. For maximum accuracy, repeat each of the tests 10 to 12 times and average the result.

The signal level in microvolts corresponding to db below 0.1 microvolt is given in Table I. Locate it there and move to Fig. 3, the graph of signal versus bandwidth by noise figure.

Enter the graph from the side with effective noise bandwidth, and move across until you intersect the line corresponding to signal level in microvolts. The diagonal lines are noise figure; if one passes through the intersection point, read noise figure in db from it. If not, interpolate between the lines.

In reading Fig. 3, use the 10 kc-100 cps scale with the .01-.1 microvolt scale, and the 100 cps-1 cps scale with the .001-.01 microvolt scale. If your bandwidth-signal level combination falls off the graph to the left, use the *lower* signal-level scale with the *higher* bandwidth scale and subtract 20 db from the resulting noise figure.

In the happy event that all your errors (and our approximations) cancel out, you'll find the noise figure to be the same at both the narrow and the broad bandwidth positions. However, it's more likely that you'll measure different noise figures at different positions of the selectivity control. It's safest to take the highest noise figure measured as being closest to correct, but you can average them if you prefer. Either way, you will probably be within 1 db of the real figure—and this is as accurate as most noise-generator techniques can be, also.

That completes the measurement, but before we wind this up let's take a more detailed look at the idea of "effective noise bandwidth" which is such a key part of this measurement technique.

Most of us are familiar with the idea of a "perfect" curve for receiver selectivity such as that shown at A in Fig. 4. Here the receiver has equal response over the desired band, and response drops to zero at the band edge. Such a curve is said to have a shape factor of 1, and is of course impossible to achieve in practice.

Now back to noise; it's spread out equally over the spectrum. A noise bandwidth of 1000 cycles per second contains 10 times as much noise as one of 100 cps. Thus "noise bandwidth" inherently has a shape factor of 1.

Since such a shape factor is impossible to achieve, it follows that "noise bandwidth" and actual receiver bandwidth must differ. If receiver bandwidth is measured at the —60 db points, the noise bandwidth will always be smaller than this receiver bandwidth. If receiver bandwidth is measured at the points where response drops 1 db below peak, the noise bandwidth will always be greater.

The mathematical expression for noise bandwidth is an integral equation involving differential gain, which is a cumbersome thing to solve. In general, the noise bandwidth of a receiver is said to be approximately equal to the bandwidth between points which are 3 db down from peak response.

db BELOW 0.1 MICROVOLT	MICROVOLTS
3	.07
6	.05
9	.035
12	.025
15	.018
18	.013
20	.01
21	.009
23	.007
24	.0063
26	.005
29	.0035
32	.0025
35	.0018
38	.0013
41	.0009

Table I.

In practice, if the shape factor (6 to 60 db) of the receiver is 2, the effective noise bandwidth will be approximately 1.3 times the 6-db bandwidth. If shape factor is between 2 and 10, noise bandwidth will be approximately equal to the square root of the shape factor (6 to 60 db) times the 6-db bandwidth. Few receivers have shape factors greater than 10.

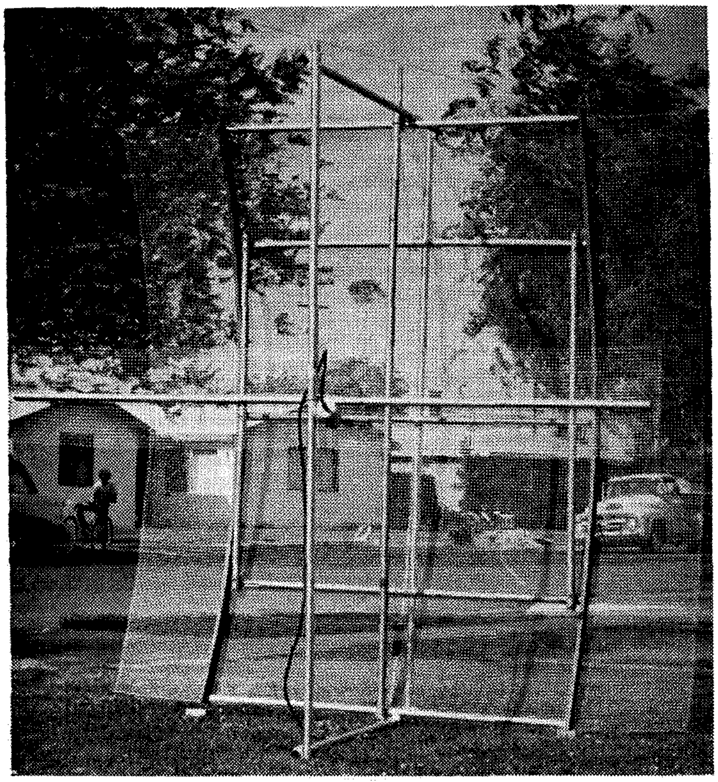
The approximations quoted earlier (1.5 times marked bandwidth for SSB-selectivity receivers, 3 times marked bandwidth for others) are based on these relations. If you're really interested in calibrating your receiver's noise bandwidth for using this measurement technique, however, you might take a converter and have it measured for noise figure by the generator technique, then run this technique backwards to determine the effective noise bandwidth of your receiver in each position of the selectivity control.

The technique described here, incidentally, assumes that no audio filters are used following the detector. If they are, all results are off, since the effective noise bandwidth will have been changed in an unpredictable manner by the audio filters.

However, you can remove the audio filters from the hookup for measurement purposes, determine noise figure, then return the audio filters to the circuit and run the measurement backward to find out your effective noise bandwidth with filters present. Don't be surprised if it comes out in the region from 1 to 10 cycles per second; a good audio filter can work wonders with weak-signal reception.

For additional details on this technique of measuring noise figure, you can consult Reference Data for Radio Engineers, 4th edition, published by IT&T and available from Radio Bookshop, or any good radar text.

. . . K5JKX



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The Big Sail

The Ultimate for 70 Cm.

The 432 Mc band has over the years, offered a fertile proving ground for antenna designs. However, building antennas for 432 involves some considerations and problems that are not evident at lower frequencies.

The close tolerances required by parasitic arrays such as the yagi become difficult to handle. Designs that work well at 144 Mc give very disappointing performance when scaled down to 432.

In many cases, the failure of such yagi layouts is the fact that the antennas are built "according to the book" and not on a test stand where the various parameters can be varied to compensate for factors the "book" failed to take into account.

However, even with yagis which have apparently been tuned properly, there are stories in circulation about antennas which showed good patterns but poor gain, though why this would be I don't know.

In any case, the yagi, even if working properly, is a delicate beast and suffers from rather severe bandwidth limitations.

True, if operation on 432.000 ± 3 Mc is all that is desired, then the 6 to 7 Mc bandwidth of the yagi would be acceptable—assuming you could get your antenna to peak on the *right* six megacycles. If TV or some other broadband operation is desired, even a working yagi leaves something to be desired.

Various types of colinear—broadside arrays can be made to perform quite well. The extended, expanded H arrays can and do deliver about 15 db of gain while 32 element

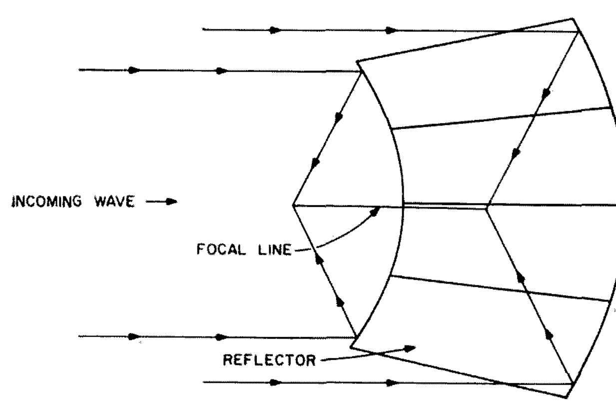
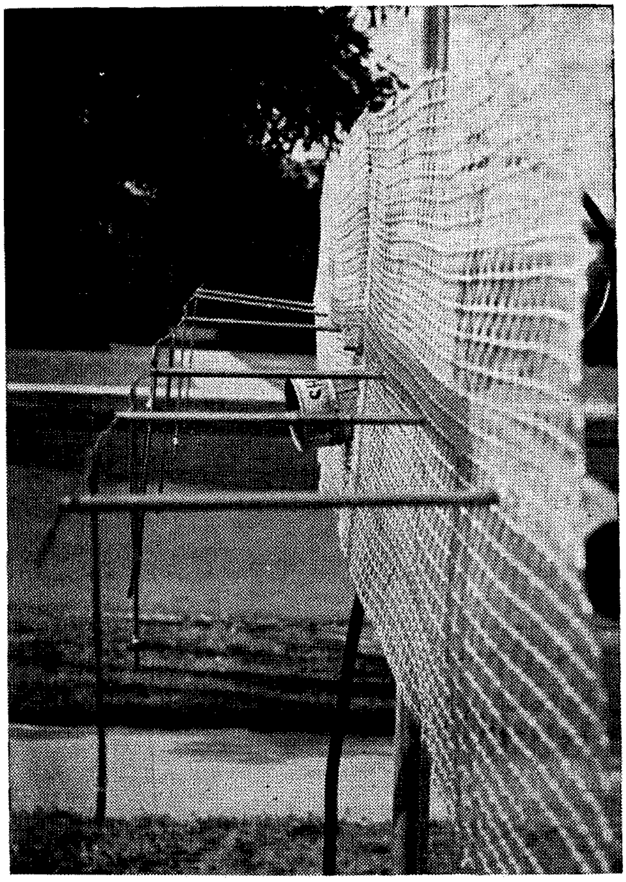


Fig. 1. Focus action of the cylindrical parabola.



Side view of collinear feed.

units have been measured at over 17 db.

Though they are much easier to make work than the yagi, the large colinears have one drawback in common with the yagi and any other multi-element array—the more elements, the higher the Q and the narrower the bandwidth. Unlike the yagi, you can reliably increase the gain of the colinear by adding elements. However, the bandwidth will be reduced, though it is difficult to say to what precise figure.

When it was decided to build some sort of "ultimate" antenna for 432, several basic requirements were established. It was concluded that the antenna should have a minimum honest gain of 18 db referenced to a dipole, the widest bandwidth possible up to the limit of the band edges; and electrical and mechanical simplicity that would guarantee ease of tune up and reliability of operation.

The yagis were immediatly discounted on the basis of a number of previously unsatisfactory experiments.

The collinear broadside was given considerable thought but the idea was set aside on the basis of the feed harness nightmare involved in feeding what would have to be a minimum of 64 elements.

The high gain, broad bandwidth requirement suggested a parabolic dish. Certainly nothing could be much simpler to feed than a single dipole and the reliability of the antenna should be considerably higher than any of the other types considered.

However, the conventional dish (paraboloid of revolution) is mechanically difficult to construct. The curve in two planes makes it difficult to get a smooth surface on the dish without considerable trouble.

Another, less familiar, form of the paraboloid reflector—the parabolic sheet or cylindrical parabola—was then studied. This is merely a sheet of reflecting material bent into a parabolic shape in one plane only. Mechancally, such a device is very easy to construct with simple tools and a minimum of expense.

As has probably occurred to many readers, the sheet parabola has a distinct electrical difference from the dish parabola, that is, its focus is not a point, but, rather, a line, as diagramed in **Fig. 1.** In order to extract the maximum amount of energy incident on the reflector, it is necessary to place an energy extractor (antenna) all the way along this focus line. Some sort of simple colinear or broadside configuration would seem ideal depending on whatever other considerations might arise.

The original gain requirement put forth was 18 db. A quick investigation of some antenna charts shows that a 9 foot circular dish would provide just about 18 db computed by radar formula. The area of a 9 foot circular dish is 63.6 square feet. A square parabolic sheet 8 feet on a side has an area of 64 square feet and should, if properly fed, produce about the same gain. The approach seemed to hold considerable promise and it was decided to build such an antenna and give it a try.

One of the first problems was the choosing of the focal length of the dish. In order to minimize electrical coupling between the reflector and the driven element, it is desirable to use a focal length of several wave lengths with all parabolic reflectors. Though a little short, a focal length of 4 feet—2 wave lengths— was settled upon. In order to operate properly at 432 Mc it is necessary that the "peak to peak" deviation of the dish surface from the true paraboloid shape not exceed 1/8 wave length or about 1½ inches. This is necessary, if the performance is not to be degraded by phase cancellation. This tolerence is very easy to maintain. In fact, the tolerence achieved on the sheet was better than ½ inch by a fair amount and no extrordinary care was necessary. The reflector itself would be quite satisfactory for 1296 Mc

(and have about 28 db gain, but that's another story).

Reflector

Table 1 shows the measurements of the parabola at 6 inch intervals each side of the center. **Fig. 2** shows how these were laid out and marked on a sheet of 5/8 inch plywood eight feet long and 24 inches wide.

Several 10 foot lengths of inexpensive TV mast were obtained and four of them were cut in half, yielding eight pieces 5 feet long. Five of these pieces will, with the plywood slats, be used as the basic framework for the reflector surface. The mast should be of some material other than alumimum.

The mast tubing pieces are attached to the plywood at equal intervals by placing a 10 - 32 screw through the tubing about one inch from each end. The eye of a two inch eye bolt is threaded onto the 10 - 32 screw inside the tubing as the screw is placed through the tubing. The threaded portion of the eye bolt should then extend about one inch from the end of the tubing.

The eye bolts are then inserted into holes drilled into the plywood slats and held in place with a nut and large flat washer on the other side.

The mast pieces are attached so that their back edges are just flush with the back edges of plywood slats. This is necessary because the reflecting surface, when attached, will be applied to the back side of the framework and both the slats and the masts will be used to anchor the surface.

In order to minimize any twisting or skewing of the antenna two 5 foot masts are attached across the second and fourth masts in the framework next to the slats with TV antenna U clamps. This adds considerably to the rigidity of the antenna.

The next requirement will be about a 19 ft. length of 4 foot wide ½ inch mesh hardware cloth. This length is cut in half and the two 9½ foot pieces are laid side by side and tied together with tinned copper wire. The lacings should be soldered to the mesh to assure good electrical connection and mechanical stability, though this can be done later, if desired.

The framework should be laid on the ground, face down, and the mesh should be laid across it so that the seam in the mesh runs along the long dimension of the framework. Place the mesh so that one end comes flush with the tubing at the top (or bottom) of the framework. Tinned copper wire is then used to attach the mesh to the framework. The mesh should be pulled tight and it should be attached starting at one end (top or bottom) and proceeding to the other end.

When the mesh is attached there should be something more than a foot of hardware cloth left over at one end. This should be cut off and saved; it will be used later. The mesh can now be spot soldered to the tubing with a propane torch to insure that it is firmly in place.

The mesh will overlap the narrow dimension of framework by 1½ feet on each side. The corners of the mesh have a tendency to curl because of the lack of support. This can be corrected in a number of ways. One way which works quite well is to reinforce the top and bottom edges of the mesh by running 2 foot lengths of brazing rod along each side of the top and bottom masts in the frameworks. They are extended 1½ feet past the ends of the masts and soldered to both the mesh and the masts.

This procedure will add considerably to the rigidity of the corners of the mesh.

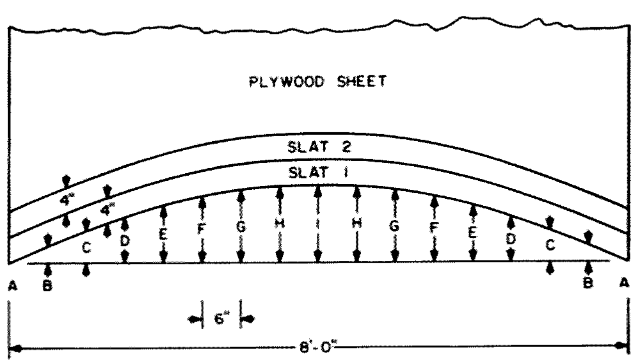
Several coats of lacquer applied to the plywood slats will help protect the wood from the elements.

Driven Array

The reflector now being essentially finished the next problem is to feed it properly. Some sort of an array must be constructed to extract energy from the focus line of the reflector.

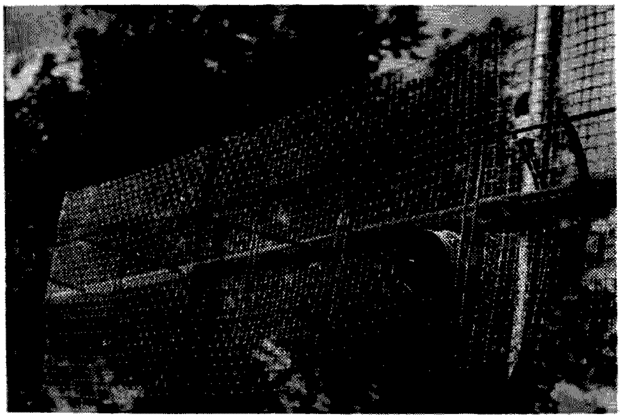
At this point it might be well to digress from the construction discussion and consider some of the theoretical aspects of feeding a parabolic reflector.

The basic problem in feeding the dish is



A	0"
B	2-13/16"
C	5-1/4"
D	7-5/16"
E	9"
F	10-5/16"
G	11-1/4"
H	11-13/16"
I	1'-0"

Fig. 2. Plywood layout. Table I. Values for parabolic curve.



Detail of balun.

one of illumination. That is, placing the energy on the dish surface in the most efficient fashion. The field pattern of the driven element (or array, as the case may be) should be such that a maximum amount of energy is directed at the largest possible amount of reflector surface. If the pattern of the driven element is too broad, then excessive amounts of energy will miss the dish entirely and be wasted. If, on the other hand, the pattern is too narrow, the full width of the reflector is not used and gain is therefore lost; the effect is the same as using a smaller dish to start with.

It is because of the necessity of a compromise between these two somewhat conflicting factors that the effective aperture or capture area of dish is always smaller than the physical area of the dish. Values of 0.5 to 0.7 are typical.

Several of the handbooks consulted indicated that the gain of a 9 ft dish was about 18 db. Some neglected to mention that this was based on an aperture of .55. This value was used for radar applications where it was necessary to limit sidelobes to a minimum. This is done by under illuminating the dish. Gain is sacrificed but sidelobes are reduced. The dish, in this case, is illuminated so that the field at the edges of the dish is 10 db down from the field at the center.

For most amateur applications, a sidelobe or two is of no consequence and the extra gain that could be had is most desirable. Hence, rather then feed the dish with the radar pattern—to the 10 db points of the feeder pattern—the dish should be fed for maximum gain. This requires that the dish be fed with the feeder pattern to about the 3 db points. This will result in maximum gain and an effective aperture of about 0.7.

The final result is a gain of not 18 db but closer to 19.3 db with reference to a dipole or about 21.5 db with reference to an isotropic radiator.

This discussion of illumination has been primarily concerned with the paraboloid of revolution. It is, however, likewise true of the parabolic plane of the parabolic sheet.

A little geometry will reveal that the 3 db beam width of the feeder in the parabolic plane should be in the neighborhood of 110 degrees.

This pattern will be compressed considerably by the parabolic shape of the reflector and the reflector will, by this compression, produce the final beam width of the sheet in the parabolic plane.

In the other plane, the "flat" or non parabolic plane, the feed should simply exist all along the focus, whatever beamwidth the feed itself has will simply be reflected by the sheet and will become the final beam width of the sheet in the flat plane.

The feed array which seemed most likely to satisfy these requirements was a seven element series fed collinear. This is, in essence, a string of dipoles laid end to end and end fed, in phase, by a series of half wave delay lines (quarter wave shorted stubs).

This type of array has several good points. The series feeding system elliminates the necessity of the usual feed harness, it allows very simple adjustment of the dipole phasing for optimum gain and it virtually elliminates the necessity of insulators and allows rigid all metal construction.

Fig. 3 shows the various dimensions of the array. The array is bent from a single piece of #10 soft drawn solid copper wire.

The dipoles are supported at their centers on the ends of ¼ inch brass tubes. The tubes are mounted in quarter inch holes through an 8 foot long piece of TV mast. The lengths of the brass tubes should be such that the dipoles are supported ¼ wave—6 3/8 inches—from the front edge of the mast.

After the tubes have been attached to the mast but before the dipoles are added, a piece of the left over hardware cloth 8 feet

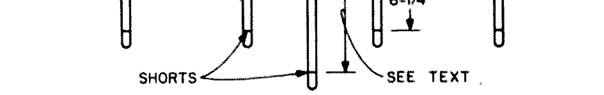


Fig. 3. 432 Mc collinear dimensions.

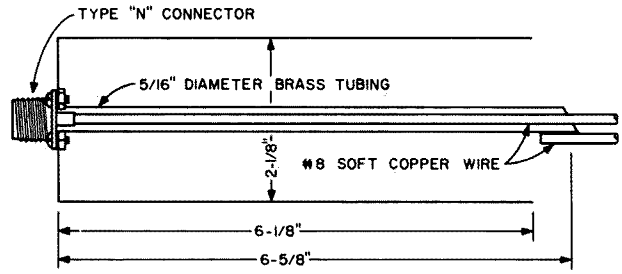


Fig. 4. Balun dimensions.

long and 14 inches high should be attached to the dipole side of the mast.

The mesh can be held in place with wire and then spot soldered to the mast with a heavy iron or propane torch.

The dipoles should then be soldered in place.

It will be noted from Fig. 3 that the ¼ wave phasings stubs are actually longer than the length required and that shorting bars are used to set the final adjustment. In all probability, this array will perform properly if the shorts are set to the measurements given, however, if the time can be spared, a simple diode test stand step up with a signal source of some sort will allow the array to be tweaked just to be sure.

If the test stand method is used, it should be found that, when the shorts are tweaked for maximum gain, the horizontal beam width of the antenna is at a minimum which should be about 16 degrees.

As with many antennas, the beam direction can be changed by altering the phasing balance among the dipoles. Be sure to set all the shorts the same distance. It is possible to achieve the proper beam width and then squirt the beam out sideways, if the shorts are not pretty close to the same length.

To illustrate the necessity of proper phasing, Fig. 5 shows the E plane pattern of the first trial collinear which was built "by the book." The screen reflector was not used in this test. The unidirectionalness of the pattern was apparently due to the reflecting action of the length of tubing used to support the dipole string.

In contrast, Fig. 6 shows the pattern obtained in the E plane with the second trial collinear, which was also without screen reflector. In this case, the phasing stubs were made longer and the movable shorting stubs added and adjusted for maximum gain.

It can be seen that the second antenna has a much cleaner pattern, lower sidelobes and narrower beamwidth.

Though not shown, the H plane beamwidth of this antenna is much too broad to satisfy the feed requirements of the parabolic sheet.

Fig. 7 shows E plane plot the final array. This was built like the second trial except that the reflector screen was added and the stubs retuned as required.

The sidelobes are further reduced and the back lobe is almost completely suppressed. The H plane beamwidth is reduced to about 100 degrees which is a quite satisfactory value for the feeding sheet. In fact, the array is, in itself, a fairly decent antenna, which, if used without the parabolic reflector, will have about 10 db gain.

The collinear is mounted at the focus of the sheet by using four additional lengths of TV mast. Two 5 foot lengths and two 8 foot 4 inch lengths are used to form the collinear support which is held together and to the sheet by antenna U clamps.

Reference to the photographs will provide the details of this construction. The U clamp which ties the mast behind the sheet to the center tubing in the framework is particularly important if the collinear support is to remain rigid.

The collinear is then clamped at the focus of the sheet.

Two lengths of nylon rope were tied between the edges of the framework and the ends of the collinear to insure against the collinear twisting on its mount. If this were to happen the pattern would be upset and, if carried to an extreme, the effectiveness of the antenna would be destroyed altogether.

To this point, nothing has been said about the matching scheme used. It will be noted that the middle dipole in the array is split at the center and a shorted stub has been inserted.

The center impedence of the array is rather low and requires a balanced feed. The simplest matching arrangement seemed to be the "beer can balun," in this case, a soft drink can balun" and shorted stub match.

The balun is used to transform the 50 ohm unbalanced transmission line to a 50 ohms balanced shorted line. The 50 ohms balanced line is tapped onto the shorted stub. The tap point and the short are positioned for minimum VSWR.

The details of the balun are shown in Fig. 4. These details vary slightly from the balun shown in the photographs, however, they are essentially the same. It is also well to note that the short 50 ohm balanced line is not actually 50 ohms but somewhat higher,

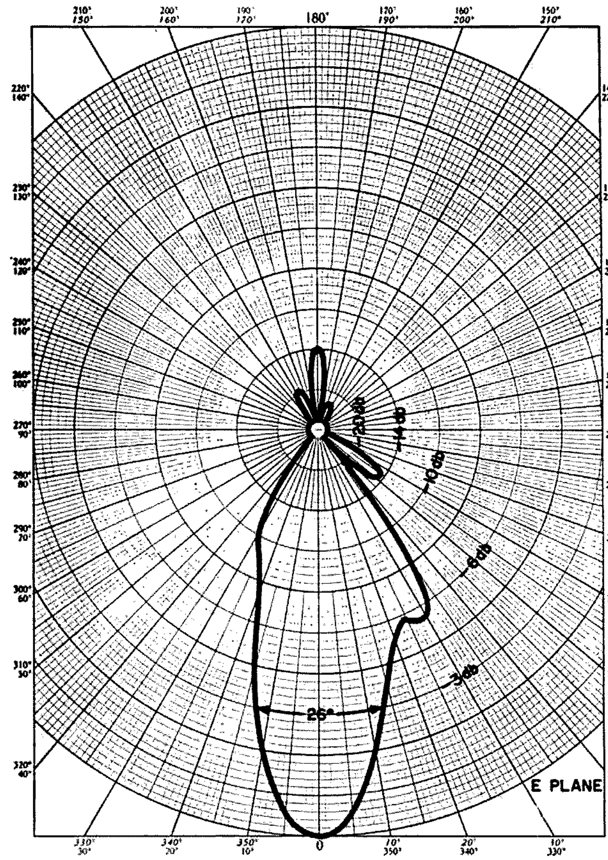


Fig. 5. First trial array.

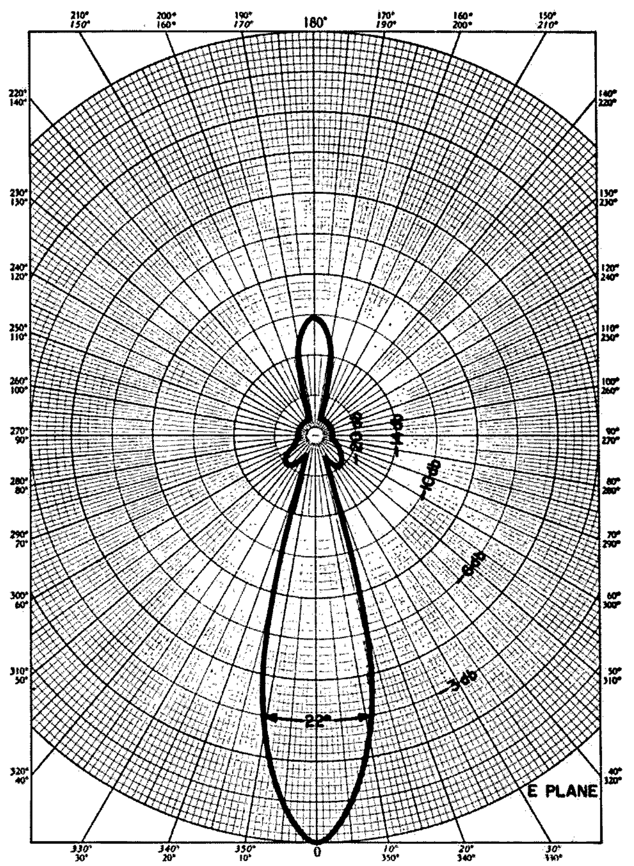


Fig. 6. Properly phased array without screen reflector.

but the discontinuity is short and can be tuned out in the normal stub matching procedure.

Once the stub is tuned for minimum VSWR, it is well to check the match with several different lengths of transmission line to be sure that the line itself is not acting as a part of the matching network—it can happen. If the VSWR remains low with varying lengths of line, then the match can be assumed to be proper.

When the line is matched the balun can be bolted to the dipole mast.

Quick checks showed that with the antenna tuned for 436 Mc, the VSWR was below 1.5/1 across the entire band and below 1.2/1 from 425 Mc to 445 Mc.

Though less thoroughly checked, indications are that the gain was acceptable over the band. Very little difference was noted between the gain at 436 Mc and 432 Mc.

Transmission line losses at 432 Mc can present a formidable problem, however, if the shortest possible length of RG-8 foam line is used losses can be kept to a minimum. Needless to say, if RG-17 is available, a substancial decrease in losses can be wrought, if the line is lengthy. It is sometimes possible to obtain lengths of used RG-17 quite reasonably from commercial two-way radio communication companies.

The weight of the antenna poses a problem in mounting the antenna atop your tower or mast. The fully assembled antenna weighs about 60 pounds.

Conventional TV mast, even the heavy duty variety, will result in disaster. Instead, a length of one inch heavy wall rigid pipe was used. This has a one inch inner diameter and a 1/8 inch wall.

The photographs show the temporary main support mast across the face of the sheet which was used in the test stand checks.

The antenna should be mounted very clos to the rotator to allow a minimum amoun of sway. The wind resistance of the antenn is fairly high and every practical precautio should be made to insure it doesn't end u a pile of junk in your backyard, or, wors yet, a neighbor's yard.

A rotator with an external thrust bearing should be used. If possible, the bearin should be mounted three feet or more below the rotor to minimize sway strain on th rotor and the top of the tower.

It was found that, if the thrust bearin was true with the rotator, my seven yea old Alliance Tenna Rotor would turn the sheet and the 6 element six meter beam mounte directly beneath it, without seeming unreliable.

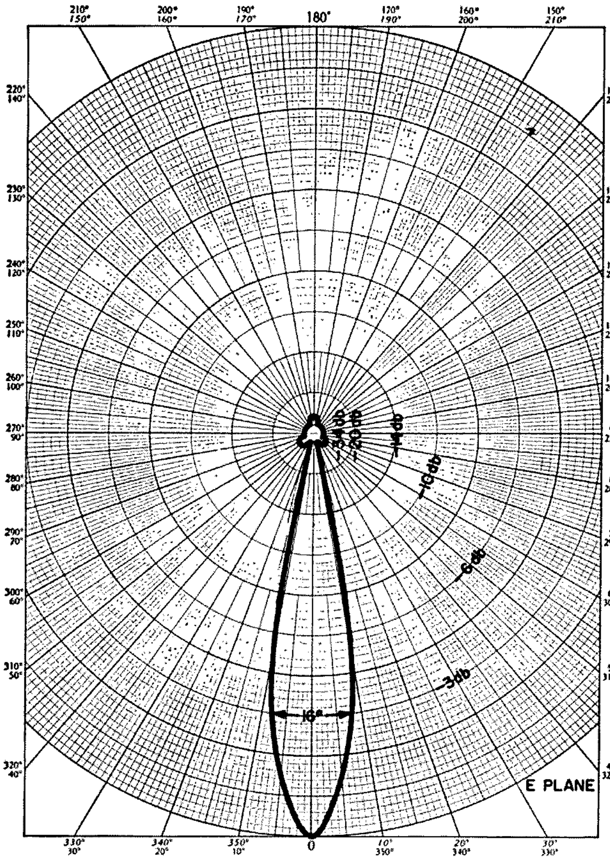


Fig. 7. Array with λ/2 screen reflector.

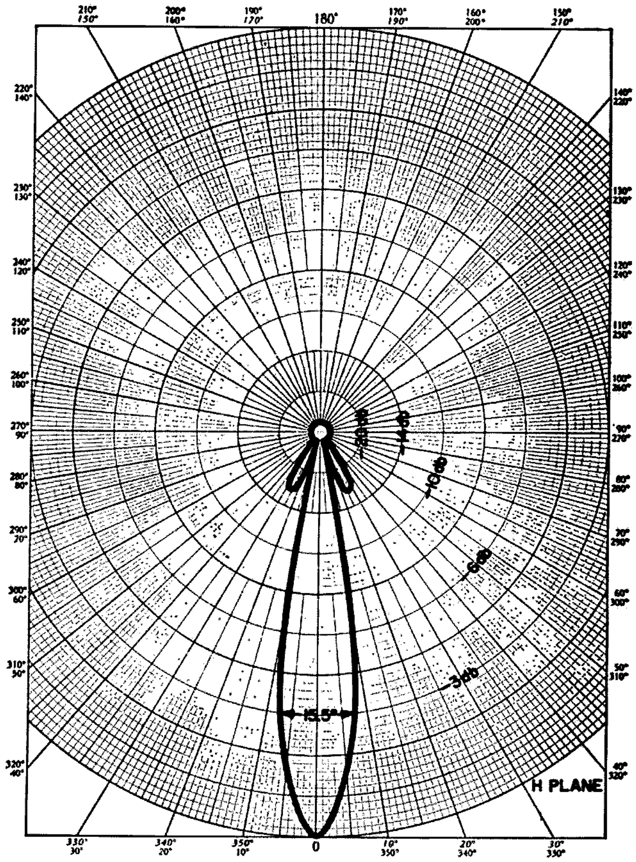


Fig. 8. H plane plot of the parabolic reflector.

Fig. 8 shows the plot of the H plane pattern of the sheet reflector. The E plane plot was observed to be almost identical to the E plane plot of the driven array (Fig. 6) except that the F/B was better and sidelobes were slightly stronger.

Using conventional gain, beamwidth formula the forward gain, based on the measured beamwidths, is 19.3 db. This is almost exactly the predicted value and is a happy place to stop.

To be scientifically correct, a statement of measurement tolerences would be appropriate at this point. The instruments used in these measurements were not laboratory calibrated, but rather were homebrewed and not at all fool proof. However, I believe that the measurements were accurate within a degree or so. If both beamwidths were off by as much s 3 degrees (20%) the gain would still be over 18 db. Though, regardless of "paper gain," on the air results are the most important criterion for a judgment of performance.

The front to back ratio seems to be in excess of 40 db on the test stand. When the ntenna was actually put into service, the ront to back ratio seemed to be less than his value, in some cases, by a considerable mount. Later tests seemed to indicate that he f/b was actually quite high but the strong forward lobe was picking up signals reflected by ground objects in the general vicinity of the antenna. By observing television sync pulse phase comparisions, indications are that objects at least as far away as 5 miles from the receiving antenna could and did cause fairly strong reflections.

The antenna has withstood the rf of the KW transmitter for long periods of time with no apparent ill effects. There were no thermal hot spots on the antenna. The high current points on the dipoles were warmed perceptably above the ambient but the effect was just noticable. The small wire used in the shorts in the phasing stubs seemed to be no problem at all.

At this writing the antenna has produced among others an R5 CW QSO over a 180 mile path obstructed by a 7000 ft mountain chain and an R5 S2 CW reception report over 270 mile path obstructed by two mountain chains, one about 8,000 feet high. In both cases, these results were obtained in spite of cross polarization.

Why call the article the Big Sail? Well, that's a local joke, but, it does look more like something that belongs on a boat than on a radio tower, or so some of the neighbors say.

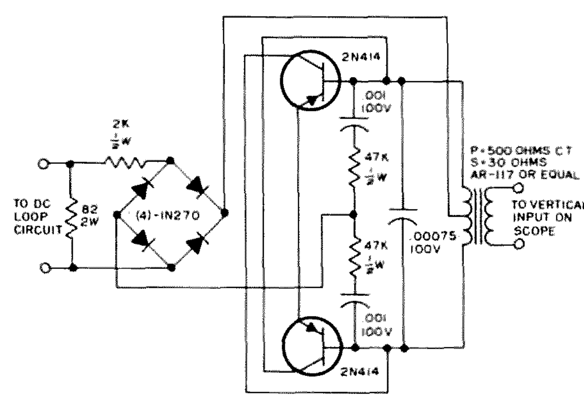
. . . K6MIO

Gordon Hopper W1MEG

Teletype Tester

Here is a useful piece of RTTY test equipment which can be built very easily. It is a transistorized tone oscillator for testing RTTY signal mark and space distortion of both received and transmitted signals in conjunction with an oscilloscope. The majority of conventional scopes are not capable of RTTY tests as they either do not have the dc input or the sweep time is too slow for receiving a strong of dc pulses. This piece of equipment will allow viewing the dc loop on a scope so that an operator can adjust the polar relays and keyboard for minimum distortion. Bouncing relay contacts can be easily seen on the scope.

The tone oscillator obtains its operating power from a small voltage developed across an 82 ohm resistor connected in series with the dc loop. This voltage is fed to a bridge circuit of four type 1N270 diodes so you can ignore polarity when inserting the unit into the loop circuit.



A pair of 2N414 transistors oscillate around 20 kc and their output is coupled to the input of the scope through a small output transformer.

Pulses containing no distortion will appear on the scope as evenly spaced rectangles. Pulses containing mark distortion will appear as evenly spaced square boxes. Pulses containing relay contact bounce will appear as pairs of rectangles on the oscilloscope.

. . . W1MEG

Gus: Part IV

In planning my first DXpedition one of the first problems I faced was getting equipment to use. I had been told by lots of fellows that getting equipment for a DXpedition was very easy. Well, maybe it's easy for some fellows but in my case it was not. I wrote a nice letter to every manufacturer I knew of telling them my plans. Only one bothered to answer my letter! That was the equipment I took with me and it must have been good gear because I had no trouble with it at all.

I began to write letters about then to the fellows who said they had spare bedrooms for visiting hams. I mean to tell you I really wrote letters, getting telephone numbers, street addresses, and directions as to how to find their homes. I also wrote many letters to the licensing people in many countries too. Let me add right here I have found that this (in my case) is *not* the best thing to do—it gives them too much time to read the fine print in their regualtions. To this day I think the "out of a clear sky" approach is the best—don't even give them any warning that you are on the way. In fact, it's best to not tell anyone where you are going, because then someone will try to beat you there, or foul you up!

I was in a lucky position that I had a good partner with me at our broadcasting station. Things were going smoothly (as smoothly as they usually go at a BC station) and it was OK for me to stay away from my station any reasonable length of time. It would operate all OK whether I was there or not. My wife had her own radio and TV shop with a good technician working for her. All the children were out of school and one or two of them were about to get married. My wife had given me the Official Nod. (I told you I had one out of a thousand wives—didn't I?)

The news of my DXpedition was really getting around by this time. The "LW" gang helped lots (14050 KC—Sundays at 1300 GMT) Oh yes, let me tell you how W5UX and I organized this "LW" net. I had always heard about these big city 2 meter and 6 meter DX nets—I think most of them have one by now. I once made a trip to Philly to visit my in laws and found out about that big club meeting there.

I sneaked into their meeting and sat down in the back row where it was dark. I heard the trial of one of their members. Up on the platform were the club's secretary, president, vice president, and a few of the club's officials. After reading the minutes of the last meeting, calling the roll, and discussing other run-of-the-mill business, they called one certain ham up to the platform to be tried. They first asked him if he were at home the past Tuesday night. He answered yes. Then they asked him if he worked a VR3 that night at about 3 am. He said yes, he had. Then they asked him if his 2 meter DX net station was in working order—he said no. Then they asked him if he had a telephone. He answered yes. They asked if he had his list of the club members who needed VR3 and he said yes. Then they asked him why he did not telephone the boys who neded VR3, and he said his telephone was in his bedroom and he did not want to wake their baby. They asked him if he had ever read the by-laws of the club about having the telephone placed where it could be used anytime day or night without disturbing anyone. I think his answer to that was that he was planning on having it moved to a better location in the house soon. Well, I think it was a $50.00 fine given to him. Right then I said

to myself, boy, us fellows in small cities just don't have a chance to work lots of good DX with clubs like this being organized like they are.

When I got back down to South Carolina I gave lots of thought to how to overcome our disadvantages of not having a big club and all their members to act as our ears for alerting us fellows in small towns across the SA. I had a QSO with Bob and told him that we fellows in towns with no DX 2 meter nets should get organized. I suggested that we start a "Lone Wolf" (LW) DX club and for us to meet every Sunday. So the LW got going—this was a number of years ago—and it still is going strong.

For a DXpedition to understand the problems the USA gang faces in working DX, I think it's the best training in the world to chase DX from the USA for a number of years. Then you see how things go with them and hear the problems that they face when working DX. Anyone not living in the USA just can't picture the sounds of kilowatts QRMing each other, or understand how eager most of the gang is to work DX. They can never understand the strength of those KW's when we have short skip; they can't picture the competition between the fellows. They just don't know how badly a DX station can get

covered up with QRM especially if the DX station is in the USA portion of our phone bands. All of this knowledge has helped me to see how a DXpedition should be run, especially when the W/K's are coming through. It's even good to know of the 2 meter net boys alerting each other when something good is coming through. The odd part is that many of the DX stations don't realize thet they have the situation in their control—if they will control things right! Danny Weil (VP2VD) taught me lots about handling the pile-ups and I think old Dick (KV4AA) taught Danny! I have heard so many DX fellows trying to handle things the wrong way that I made up my mind that I most certainly did not want to make their mistakes.

I will admit some of them don't show "good bringing up" and they do get downright dirty at times, but I figure it's all in the game. You know the old saying, "all's fair in love and war and chasing DX." With me it's no holds barred, do what you want, you can't make me mad and I won't Black List you either. Course I just might not "hear you"! hi hi. And if I work you, your call might not get into the log, and then no QSL and that's bad! You will be surprised how fine 99.99999% of the fellows are though.

When the news really gets around that you are going on a DXpedition, you begin to get lots of mail. Everyone tells you where to go, how to operate, what frequency to use, to listen for them. Some fellows offer you things to take along with you, some fellows suggest what medicines to take with you.

You can make all the plans you want when you are sitting down in your office or at home, but when you get to the rare spots, all of your plans seem to change. Things just don't work out like you thought they would. A lot of the time you just have to go along with the wind. Lots of fellows asked me if I had ever traveled much and I told them I once drove to Mexico and had also driven to Niagra Falls on my honeymoon. Then they asked me if I had ever been out at sea in a boat. My answer to that was a flat no—but I was sure I would not get sea sick. They usually answered "Brother, you have a lot to learn," or something like that. I was pretty sure that I could control things OK at sea because I had too much at stake to do otherwise—and to this day I still believe what I said! I even believe that I can control myself with mild sickness too. You have just gotta say to yourself—"Look here, you cannot afford to get sick." And if you really mean what you say, you just won't get sick—or at least you can pull yourself out

of it before it gets you down.

Things were coming along nicely on my DXpedition plans. Buck W4TO over in Atlanta, told me he would be glad to handle the QSL cards and would assist with funds. In fact, we both put money in the bank. Buck matched what I had and said he would see if he could get some contributors lined up in case their help was needed. Buck did a very splendid job in keeping me going too. It's very rough to get over-seas and have to worry about your funds running out on you. Before you do anything in the line of a DXpedition, get rid of your money troubles and worries. Stay home if that problem is not solved, unless you are filthy rich!

After a number of meetings with Buck I was ready to depart—I wanted to get going! But there were a number of things I had to do yet. For instance, I had to get my passport, and visas for the countries I wanted to visit. Don't ever mention the word radio or radio amateur to those Consulates in Washington, because they will tell you they will have to write to their home government to get your visa approved. Just tell them you will be a tourist. Tell them you want to buy—*BUY*—lots of pretty things in their country (they like that word BUY) and you will be surprised how fast you get your visa. Act like you have no money worries at all (that was hard for me to do).

At last I was all fixed with visas, all my clothes were packed (much too many too), my little address book was in my pocket, my little money was changed to Travelers Checks and my health card was OK. I had the little electronic keyer W3KVQ had built for me and that fine paddle Sandy W5AZB had made. The equipment was to be shipped to me in Amsterdam. Even a getting-together date was arranged, to meet Lee WØAIW, Mike WØ-MAF, and Mac WØUQV in Nairobi. We four were going to VQ9 land together. I could see a lot of interesting developments in the wind.

The BIG ADVENTURE was about to commence. I was going to be on the other end of the DX pile ups, and I was going to see some of the world and meet some of the DX fellows I had been talking to all these years.

When the plane left New York at 4:30 pm I decided I would let my wrist watch just stay on E.S.T. I found that Cokes were free on the plane, so I more than drank my share. I saw other people on the plane sleeping, but there was none for me. I guess I was excited too much and had too much on my mind to think about sleep. I just kept drinking Cokes and watching my watch and at 1:30 (by my watch) the sun came up., I said to myself, boy, that sure was a short night. The plane came in and landed—I was in PAØ land! Immediately I took another plane for Hamburg, Germany and then I was in DL land. Things were going just fine with me, no trouble with Customs at all (Boy I had a lot to learn)!

I was met at the Hamburg Airport by DL6ZZ—good old Brother Gus, whom I had QSO'ed many, many times and his nice XYL-Helene. Just like I had told him I would do, I ran up and planted a big kiss on Helene. I think they were both surprised when this happened, because people over there just don't run around kissing people at airports. Over the air Gus had used almost perfect English, but when we met in person I found that I really had to talk very, very slowly for him to even almost understand me. Gus and Helene went all out to treat me very, very good. They wanted my stay in Hamburg to be a memorable occasion. It seemed like we were always eating and drinking at their house. The best darn sauerkrout I had ever had, and boy, those German weiners were out of this world. (Here in Bhutan where I am now, I do good to even get yak meat. Oh yes, we do have yak butter tea a few times each day—I guess just to keep the taste in your mouth—and let me tell you, that taste sure sticks with you a long time after you have had a cup of that stuff—hi hi).

Gus evidently had taken a few days off from his work just to show me around. We went everywhere in Hamburg, which is a very nice city. I met many of Gus's and Helene's friends and many of his relatives. All of them were real down to earth kind of people and very friendly. Of course, at each house we had to be served coffee and cakes, and even at times a Coke would appear. Gus had two sons, one away in the army and one at home. The one at home had a very pretty girl friend who I got to sit on my lap and we took a picture of that. This picture was discussed at length with my ZYL when I got back home—I mean it was discussed and discussed, and a little hard to explain I must say. (Boys, be very careful of those pictures you take!)

After staying with Gus and his family about 5 or 6 days my allotted time finally ran out, and it was time for me to depart. The time was much too short and I would have liked to have stayed much longer, because I was having such a nice time. They asked me where I was going when I left, and I said East Berlin—that did it! Helene cried and Gus tried his best to discourage me going there. He told me all kinds of things that might happen to me and said it might even be a one way trip! But I told

them I had promised some of the boys in East Berlin that I was going to visit them and that was what I was going to do regardless of the consequences. I told them I was not afraid of anything that anyone would do to me. I had not done anything to anyone and I was no spy. Against their better wishes they finally more or less gave in. Then they asked me how was I going to get to East Berlin and I said by train, since it was the cheapest way and the cheapest way was all I could afford. This brought tears in the eyes of Helene again. They told me that I should not go by train ecause the train has to run nearly all the ay from Hamburg to Berlin through East Germany with police all over the place and verybody suspecting almost everyone of being a spy.

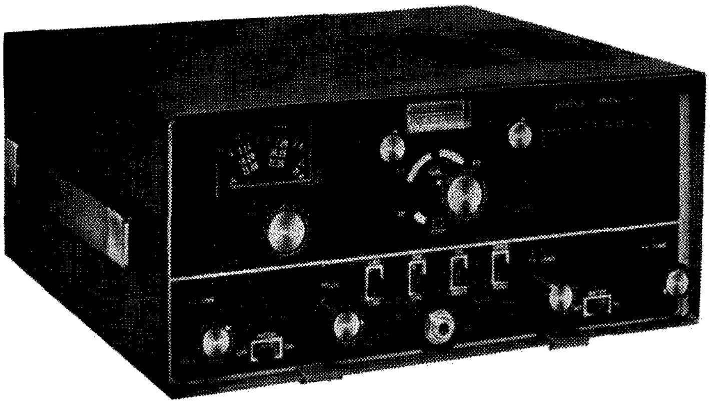
All this time, I was telephoning Amsterdam irport daily asking them if my equipment ad arrived there from New York. Up to the ay I departed for Berlin it had not arrived, hich probably was best or I might have had t with me when I arrived in Berlin, and then he fun would have started sure enough.

Gus, Helene, and their son came down to he train to see me off. They were not happy eeing me leaving for East Germany.

After the train left the Hamburg station it as not long before it stopped and the West erman conductors and train crew along with got off the train, and the East German officials he immigration officials got off the train, and of course their Police and special officers took over the train and it was under their jurisdiction from then on, until the train arrived to the border of West Berlin and East Germany. They gave me the eye any number of times. I was asked why I was going to West Berlin and what business I had there. My answer was always "I am a tourist, and I want to see as much of Europe as possible." They really went through my little suitcase, even looking in the pockets of every garment. At very stop along the way they made every passenger getting off the train show their identification pass and a few questions were asked of each person with a nod or two from the fficial asking the question. Police were everywhere at each stop along the way. I was at last seeing a police state in operation. Sometimes two or three of their Police would look at me and say something to each other. I was a little concerned about this and I wondered hat would happen before I got to West Berlin. Here was old Gus in the middle of Communism—these fellows did not smile at all. What was in store for me?—Next month, boys—

. . . Gus

Ralph Hanna W8QUR
3023 Emmick Drive
Toledo, Ohio 43606



The SB-34

When the SBE 33 came out, I knew that it was the ideal transceiver for me. I was looking for a rig that would be convenient for use on a cabin cruiser. Boat mobile is a bit different than car mobile. The boat is not usually kept at home. Once you get on it you stay at least for the weekend. This means that you have to lug most transceivers out to the car with the speaker and two power supplies and then everything from the car to the boat. Two power supplies are usually necessary because commercial power is used dockside and batteries are used when underway. But a 250 watt inverter was already installed on my boat, so with the SB-33 all that had to be carried was the one little 18-pound package and the microphone, as the speaker and AC power supply are built in.

The SBE 33 is a fine transceiver and has some real clever design features. It was covered quite well by W1CUT[1] some time back. But as with any piece of ham gear, the user will wish for improvements. Several had been thought out and were considered for a winter project when SBE came along and announced the SB-34. Here were all the improvements you could ask for: slower tuning rate, incremental tuning, provisitions for a calibrator, a dial corrector and best of all, a built-in 12 volt DC power supply, and all this at no increase in size or weight and no sacrifice in any of the plus features of the SBE 33. The new dial is marked in 5 kc division and the set covers 50 kc more of each band.

The dial corrector is a much needed improvement. It uses a varactor diode (voltage variable capacitor) in parallel with the VFO coil and tuning capacitor. Varying the voltage on it with a conveniently located pot varies its capacitance enough to shift the frequency as much as 10 kc. The delta tuning is effective only in the receive position. The same varactor diode is used by changing the voltage a bit more for about 1 kc change in the receiver tuning. Properly biased diodes cut out the effect in the transmit position so that the transmitter is always on the same frequency as originally set. This is an ideal feature for round tables and when working other transceivers that are not as stable as they might be.

The most unique feature of the SB-34 is the method of switching from receive to transmit without the use of a relay. This is real tricky. Two transistors perform this function. The base of one is coupled through a resistor to the cathode of the driver tube. In the receive condition, because of the high negative bias on the grid of the driver tube, no current is drawn and therefore the base of the first transistor is at ground potential and it too is cut off so that its collector is at +12 volts. This voltage is applied to the receive control line. This same 12 volts is supplied to the second transistor which causes it to conduct to saturation so that its collector is at ground potential. This ground potential is applied to all the controls requiring ground potential.

When the push-to-talk button is depressed, the high negative bias on the driver is grounded so that the tube begins to conduct and build up to about 6 volts at its cathode. This voltage will now cause the first transistor to conduct and thus reduce the 12 volts to zero to cut off the receiver. With zero volts on the second transistor, it will be cut off so that its collector is now at 12 volts for the transmit

1. The SBE 33, E. L. Campbell W1CUT, QST, April 1964, p. 52.

function. A third transistor will energize an external relay to control a linear amplifier. Clever, huh?

The main feature of the power supply is that it will function on either 115 volt 60 cycle or 12 volt DC. Changing power cords does the switching. This feature makes the SBE 34 a truly universal transceiver that can easily be used mobile or fixed. And it will eliminate the fuss I had with Virginia, out in the middle of Lake Erie, as to who got to use the inverter on the boat—she to watch the noon time soap operas on TV or me to keep a 1200 sked. Incidentally, there was no TVI even on the small boat.

Just to see how really good the SBE 34 is, Ray Abain K8NBQ and I took it over to Rowe Industries and put it through its paces on the anaramic Corp. Panalyzer, the Bird watteter, the distortion meter and all the other good things. Here is what we found using a ingle cycle tone:

Power Output—	80 meters	62 watts
	40 meters	77 watts
	20 meters	78 watts
	15 meters	57 watts

Carrier Suppression—56 db down from output signal

Unwanted Sideband Suppression—58 db down from output signal

Distortion Products—28 db down from output signal

Spurious Responses—42 db down from output signal

Sensitivity—0.9 mv for 10 db signal plus noise ratio

Selectivity—2.1 kc at 6 db down 4.6 kc at 60 db down

The SBE 34 has a dual speed Jackson Brothers tuning drive that moves the dial at a high rate of speed in one direction, then goes into a fine tuning speed when backed up. The high speed is 90 kc per turn and the low speed is 20 kc per turn. The slow speed moves the dial 17 kc then goes back into high speed. For someone who likes to scan the bands as I do, I think the Jackson Brother continuous 6-to-1 dial drive would be better.

The usual accessory items are available, the most important of which is the 100 kc calibrator. This is a small two transistor unit that plugs in the back and only sticks out about ¾ of an inch. A switch on the front panel turns it on and off.

Dollar for dollar you will have to look a long way to find such a small package with so many features as the SBE 34 for under $400.

. . . W8QUR

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A DC Dummy Load

How many of us have built power supplies and tested them by plugging them in and turning them on—if they don't blow up or start smoking, then they're O.K.? Probably all of us have done this at one time or another. Usually, when the supply checks out OK by this method, then all is truly well, and one can plug in the rig or whatever and get on the air.

But there are always the exceptions to the rule, such as the time recently when I built a power supply for an ultrasonic cleaner. The cleaner was to use a pair of 811-A's in class B, drawing about 350 watts dc from the power supply. The only plate transformer that I had anywhere near that rating was one of the standard 2400 volts center-tapped at about 220 ma types. This meant that the dc output from the power supply after filtering would be about 1100 volts at 220 ma—very definitely *not* 350 watts. Therefore I wanted to test the supply at a rather large overload without running the cleaner (which was not built yet anyway). This meant a large load resistor—about 3K at 300 or so watts. I had no resistors which could possibly be combined to make such a value, and a swift look at the box containing the light bulb collection told me that a lamp bank was not the answer either. A look at the local distributor's catalog decided me against buying the necessary resistors.

Just as I was about to give up, it occurred to me that a vacuum tube was really nothing more than a variable resistor. With this thought in mind, I grabbed an old 304TH off the shelf and set up the circuit in Fig. 1.

From the tube curves, I found that with about 1000 volts on the plate, I needed about 100 volts negative on the grid to make *sure* that the tube was completely cut off. When I had the load tube connected to the power supply, I then lowered the grid voltage until the tube was drawing the desired current.

While I set up the circuit originally as a breadboard-haywire affair, I thought that it was sufficiently useful to warrant its being built in a small (well, big enough to get the 304TH in) metal cabinet with the meters built in and a built-in bias supply, rather than using the laboratory power supply. Not all of us are lucky enough to have 304TH's in our junk box, and often one doesn't have any other power tube than the one in the final. Actually, any tube can be used as a load, so long as the ratings are not exceeded too much (note that I was dissipating 350 watts in the 304TH, which is rated at 300 watts dissipation). I would recommend the use of triodes, both because they are often cheaply obtained and because there are fewer problems involved in using them in the circuit. The following tubes are suggested, since they are common: 304TH, 304TL, 6C21, 450TH, 450TL, 250TH, 250TL, 810, 805, 811 or 811-A (note that the last two tubes mentioned are zero bias triodes, and that they will probably draw grid current. Design the bias supply accordingly). Naturally, any tube can be used, and if you are really desperate, you can use the one in your final but be careful not to blow the grids out of it or melt the plate. . .

Fig. 2 is the circuit of the final version as mounted in the cabinet. I grounded the center of the filament transformer to the chassis, as the transformer was only rated for 2500 volts

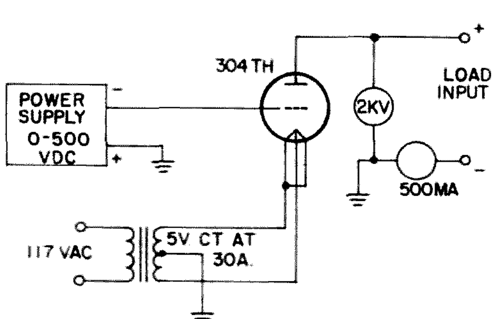

Fig. 1.

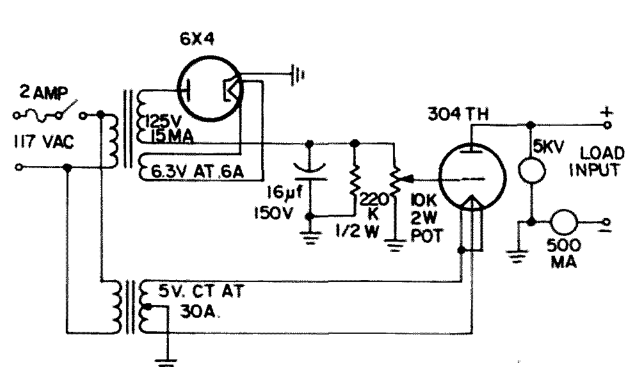

Fig. 2.

insulation to ground, and I was not in a mood to play around with that kind of fire. If you have a better transformer, it might be advantageous to isolate the entire circuit (*including the bias supply*) from the chassis. The bias supply is standard, and delivers from 0 to −120 volts. None of the values are critical. Note the 220K resistor across the filter capacitor. This is a safety bleeder and is there for the following reason: when I started to build this thing, it was about one in the morning, and as a result I chose a chassis which was too small to simply build sides around in order to make a cabinet—the meters wouldn't fit. So I had to make the cabinet larger and put the meters and controls (including the bias control pot) in the front panel with some space between the panel and the chassis. The controls were attached to the chassis by means of a cable with a plug on the end, and to make sure that the filter capacitor discharged if the plug should be pulled out, the resistor was added. A more wide-awake constructor will probably avoid most of the pitfalls into which I fell that morning. Note that since one should start to test a supply with no load (to make sure that you haven't got too much load), the counter-clockwise position of the bias control should give maximum bias voltage to the tube, and the control should be adjusted for the desired current on the meter *after* the supply is hooked up to the load.

Since this circuit will probably be used close to hand, on the bench, rather than across the room in the rack cabinet, it is worthwhile bringing up a few of the well worn but true sayings regarding safety: don't adjust the meter zero set screw when there is voltage applied to the circuit—there isn't much between you and the HV—just a little piece of plastic (and some meters use metal adjusting screws). Keep one hand in your pocket when playing around with live wires, etc. The tube is HOT—don't touch it or spill water or other liquid on it.

The circuit mentioned above is not new, but it is seldom used due to the need for more components than a simple resistor bank contains. For the experimenter, however, it has the advantage of being variable, and the parts used are such that most hams and experimenters can readily obtain them. The circuit could also be used as a bleeder resistor and could be built into a power supply if desired. Also, while the tubes mentioned have been in the 100 to 600 watt range, there is no reason why larger or smaller tubes could not be used. . . . Lyman

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Quick and Easy Add-on Neutralization

Ever build what you thought was going to be "just a simple straightforward amplifier" when you found you needed a little more gain, a little more isolation, a little more power, or all three and then find you can't eliminate self-oscillation? I just did. And it oscillated. Bad. Lit a bulb with no rf input, just from it's own nasty little internal grid-plate capacity.

This was a 5763 amplifier on 50 megacycles driven by half of a 12AT7 crystal oscillator. Nothing to it. Done every day. But, after it was built with great care to make a nice input circuit, which tuned well out on both sides of 50 mc, very complete shielding, and an equally nice tuning plate circuit, it had self-oscillation.

Now I've fought this sort of thing since 1938, and that's about 26 years, but I find there's still a lot to learn. So young lads starting out today probably need a little assistance. I sure did. Now what do the books say? Some of the "best" are worse than useless! Listen to this one. "Any amplifier will oscillate if sufficient energy having the same frequency and the same phase as the grid voltage is fed back from the plate circuit to the grid circuit."

If you think a little about the energy fed from a plate to a grid by the internal Cgp of the tube, you will see that this is in *phase* or nearly so. And this is not the proper phase for a vacuum tube oscillator, which as I'm sure you know, should be *out of phase*. Grid going positive, plate going negative, etc. Actually a tube which is self-oscillating does so in spite of the phase effect. There is some phase shift in the small Cgp and the frequency of the plate and grid circuits are *not* exactly in tune either. Remember how a crystal oscillator tunes "up one side" and then jumps out of oscillation?

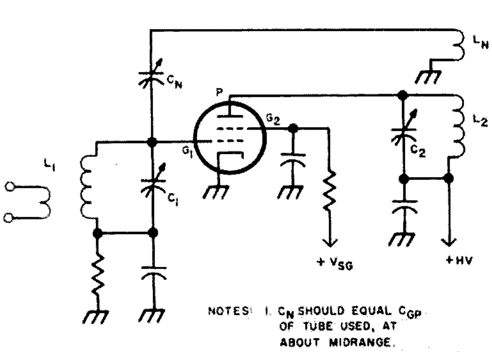


Fig. 1. "Outboard" neutralizing circuit.

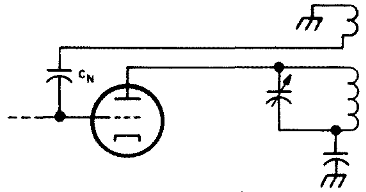
Now the funny thing is that proper neutralizing energy which is fed back by the neutralizing circuit is in the correct phase for oscillation! That is, 180 degrees out of phase. Of course, if you will look back at the previous paragraph you will see that the nuisance feedback from plate to grid through the GP capacity is in phase, so that neutralizing energy would have to be out of phase to cancel it.

Let's take the tube I used above, the 5763. Here's a good tube. Used in loads of circuits. Does anyone tell you whether or not it has to be neutralized? No Sir. I haven't found a word on that yet. You look up the Cgp and find that it is listed as only .3 (three tenths) of one micro-micro-farad. That's pretty small isn't it? Or is it? Will it self oscillate? Should you first build a split tank with a neutralizing capacitor over to the grid? You'd think the handbookers suddenly ran out of ink! Let's look at a tube which we know is generally not neutralized. The 6BA6, for example. Ah hah! The Cgp is only .0035 max. Thirty-five ten thousandths of a micro-micro-farad. That's real small!

The 807 has a Cgp of .2 mmf which is where a lot of that tube's instability comes from. In the 2C39, a triode, but generally used in grounded grid circuits, with the cathode the active element that could generate trouble, we find that the Ckp (note, plate to *cathode*) is .035 max. Not quite as good as the 6BA6 but a good deal better than a lot of other transmitting tubes.

So, how do you know when to build a neutralizing circuit in or not? You don't really. The books don't tell you. I generally figure that when the Cgp is in two decimal places or less, like .05, you *may* not need to neutralize. If it's in the tenths, like .2 or more, you probably will. You can also see that due

Fig. 2



CONNECTIONS FOR COILS WOUND THE SAME DIRECTION

to the natural-born increase in power through a small capcitor with increasing frequency where this will lead you to on VHF or UHF.

Note that the 6AK5 has a Cgp of .02, quite a bit more than the 6BA6. The 6AK5 was found in lots of places where perhaps it should not have been, but all's fair in love and war, and that was a war tube.

One of my favorite transmitting tubes is the quick-heating 7 watter, the 5618. However, its Cgp is .24 so I have always had to neutralize it.

So by now you get the general idea, and if you did build that amplifier without the usual neutralizing tank circuit, or can't make up your mind, or just plain don't want to, never mind. We are about to show you how to add it on later as an after thought. Easy like. You know, "No time like the future for things that don't stuit yer." Of course, you *may* belong to the "No time like the present for things that aren't pleasant" school.

Actually, this neutralizing circuit works even with a high-gain grounded cathode triode on two meters, so I'm going to try it every time from now on myself. Even on 432 I hope.

So far it has worked every time. Just build up a good grid circuit, use good shielding, a good plate circuit, fire it up, watch your grid drive go as you tune through resonance with the plate circuit, and then go to work and neutralize it. Of course you can build it in first, if you insist.

Just put a few turns of reverse phase winding (Ln) in or around L2 and couple it over to the grid, through the shield, with Cn for amplitude adjustment. Remember that this reverse phase is just what the doctor ordered

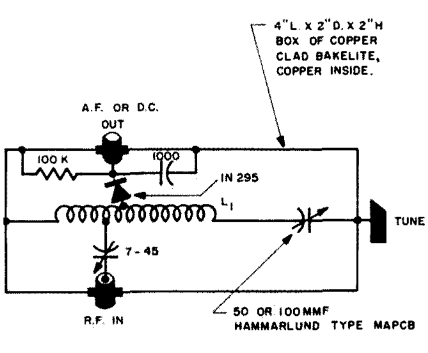
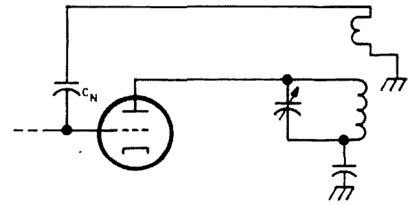


Fig. 4. Tuned detector.

Fig. 3



CONNECTIONS FOR COIL L_N WOUND OPPOSITE DIRECTION

to make an oscillator and can be done in more ways than one. If you wind Ln in the same direction, that is clock-wise, or counter-clockwise, as L2 is wound, use the opposite end from the plate to get the out of phase energy. See Fig. 2.

If you wind it in the opposite direction from the plate coil L2, use the same end to get the out of phase energy. See Fig. 3.

There's a real fancy deal going on here in fundamental magnetic coupling like left and right hand snail shells, but we'll leave *that* to the *Scientific American*. Some smart transformer people can wiggle three fingers so as to point in three different directions at once, and call this the magnetic rule of thumb. Never mind, just remember "with a tube oscillator coil, put the plate on one end and the grid on the other."

Also, you can put Ln almost anywhere and it will work. On the end of L2, interleaved, inside L2, or outside. I've tried it.

To adjust Cn, do like the books say. I use a tuned circuit detector. It helps to be sure just what frequency you *are* neutralizing. Plug the detector right into the output jack, but, unless you have lots of spare diodes, don't turn on the amplifier plate and screen supply!

It is really helpful to watch that meter (the diode meter) go down to, or near, zero, in the neutralizing null. It kind of restores your confidence in the fact that, if the theory you're using is correct and if your circuit is built right, it is a law of nature that it must work! And, I almost forgot, you can use that same detector, with a little transistor amplifier and a pair of "Hi-Fi" padded earphones, the kind with the real big large pads on them, to listen to your own modulation. But don't plug it into the rf output with the power on! Just have it nearby! And be sure it's the *diode* you're listening to. The af amplifier can pick up rf and rectify it plenty loud, but you won't like that modulation. Another reason for the tuned detector. It works FB for almost any purpose. It also goes to 432, with a strap for LI. Also ditto for a 1215-1296 megacycles detector.

I hope this helps you to make better rigs easier, especially on VHF and UHF.

. . . K1CLL

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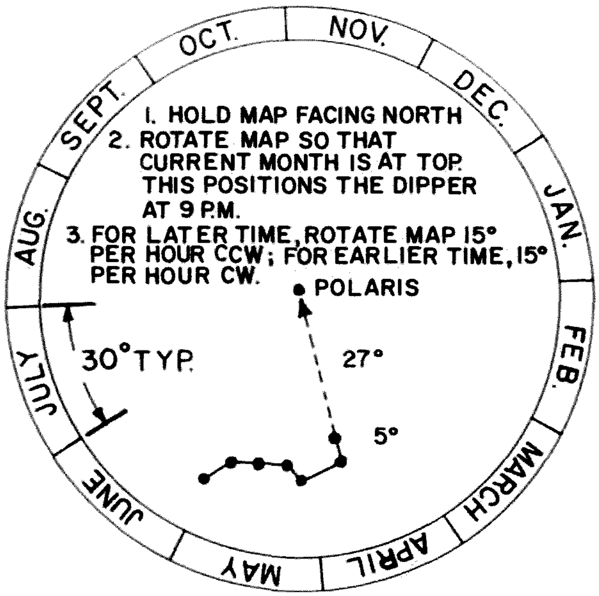
DIAGRAM A



Polar vs. Solar Beam Orientation

One of the common methods of orienting a beam antenna is to align the boom in the direction of the Pole Star. Since Polaris rotates daily counterclockwise around the north celestial pole in a circle whose radius is approximately 1°, the error in true north indication need not exceed 1°.

To assist in locating the Pole Star, the "Pointers" of the Big Dipper are often used as a guide. Instructions are given in Diagram A for proper identification of the Pole Star.

Using the angular distance of 5° between the Pointers as a yardstick, one easily identifies Polaris as a fairly bright star (second magnitude) 27° from the top Pointer at an altitude above the north point of the horizon corresponding to the observer's latitude.

The Polaris method of beam orientation is not available to observers in the southern hemisphere because there is no accommodating star of comparable brightness close to the south celestial pole. One shaft of the Southern Cross (Gacrux to Acrux) points roughly to the south celestial pole and could be used in a pinch. On the other hand, the solar method is good anywhere in the world

TABLE I LMT OF SUN'S MERIDIAN PASSAGE

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	1203	1214	1212	1204	1157	1158	1204	1206	1200	1150	1144	1149
10	1207	1214	1210	1201	1156	1159	1205	1205	1157	1147	1144	1153
20	1211	1214	1208	1159	1156	1201	1206	1203	1154	1145	1146	1157

TABLE II DIFFERENCE OF LONGITUDE CONVERSION
(time in minutes)

ARC	TIME	ARC	TIME	ARC	TIME	ARC	TIME	ARC	TIME	ARC	TIME	ARC	TIME	ARC	TIME
0°00'	0	1°00'	4	2°00'	8	3°00'	12	4°00'	16	5°00'	20	6°00'	24	7°00'	28
0 15	1	1 15	5	2 15	9	3 15	13	4 15	17	5 15	21	6 15	25	7 15	29
0 30	2	1 30	6	2 30	10	3 30	14	4 30	18	5 30	22	6 30	26	7 30	30
0 45	3	1 45	7	2 45	11	3 45	15	4 45	19	5 45	23	6 45	27		

at any latitude and longitude.

All one need know is his approximate longitude and the local mean time (LMT) of the sun's meridian passage. Table I lists this LMT on the first, tenth, and twentieth of each month. These values do not vary by more than about one minute from year to year. Even if the time is in error by four minutes, the angular error of the sun's direction is only 1°.

Since our clocks are based on standard or zone time, it is necessary to apply a longitude correction, converted to time units by mean of Table II, to the nearest standard meridian. The standard meridians are theoretically spaced 15° apart to the east or west of the Greenwich prime meridian. If the station longitude is east of the standard meridian, subtract the difference in longitude in time units between your station and the nearest standard meridian from the LMT; if the station longitude is west of the standard meridian, add the longitude difference in time units to the LMT. Thus, Standard Time or Zone Time = LMT ± Long, Dif. to Stand. Mer.

To demonstrate the simplicity of the solar method, two examples are chosen.

1) What is the standard time of meridian passage of the sun at Longitude 118°20′ W on June 15?

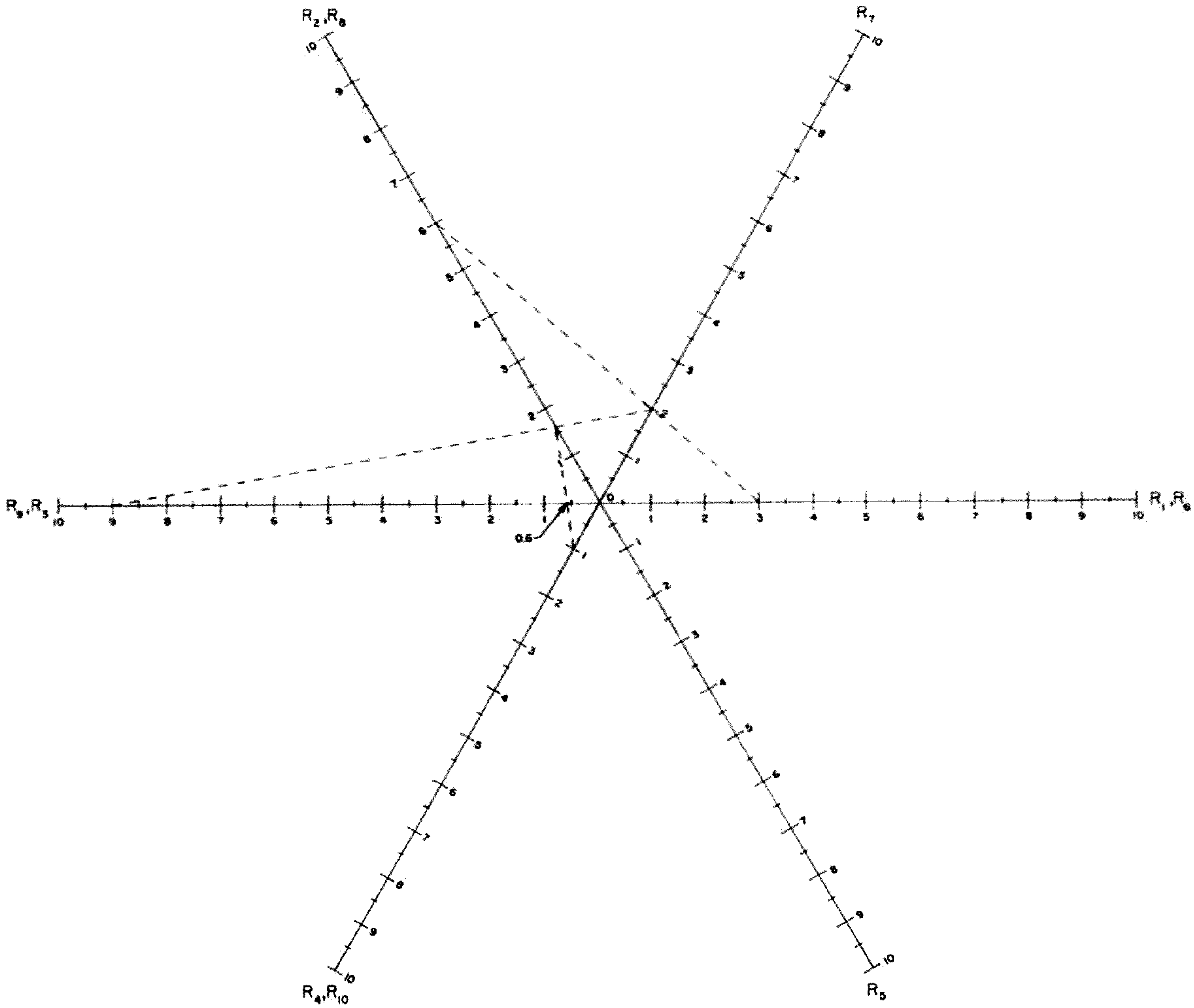
From Table I we interpolate a value of LMT = 1200. The nearest standard meridian is 120°W. The difference in longitude between the station and the nearest standard meridian is 1°40. From Table II this amounts to 7 minutes. Since the station is east of the standard meridian, Pacific Standard Time of the sun's meridian passage is PST = 1200-0007 = 1153.

2) What is the standard time of meridian passage of the sun at Longitude 40°19′E on December 8?

From Table I, LMT = 1152. The difference in longitude between the station and the nearest standard meridian of 45°E is 4°41′ which by Table II is equivalent to 19 minutes. Since the station is west of the standard meridian, Standard Time of sun's meridian passage is 1152 + 0019 = 1211.

About one minute before the sun is due south or north depending on your latitude, put on your dark glasses, stand back, point your antenna boom toward the sun as it crosses the meridian, and set your direction indicator. It's so simple; why bother to orient your beam at night with a fumbling flashlight?

. . . W6TAQ



Parallel Resistance Nomogram

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Solving for the resistance of a parallel resistance combination can be a tedious job, especially if there are more than two resistances in the combination. Series capacitors present exactly the same problem. The equation

$$R = \frac{R_1 \quad R_2}{R_1 + R_2}$$

is fine for two resistances, but even this requires computation. The above nomogram allows solution of this type of problem in seconds, with an accuracy of 3% (most resistors have tolerances of 5% or 10%). In addition, this nomogram can be used for any number of parallel resistors or series capacitors.

A glance at the nomogram will reveal that the scales are calibrated from 0 to 10. It is very important to use resistors whose multipliers are the same (same number of places after the first number). Cases where the multipliers are different will be explained later. The operation of this nomogram will be best explained by the following example.

Suppose we have a parallel combination of resistors with characteristic numbers of 3, 6, 9, and 1. These could be, for example, 3,000 ohms, 6000 ohms, 9000 ohms and 1000 ohms, or, 30000 ohms, 60000 ohms, 90000 ohms and 10000 ohms. Let us take for our example the parallel combination of $R_1 =$ 3000 ohms, $R_2 = 6000$ ohms, $R_3 = 9000$ ohms

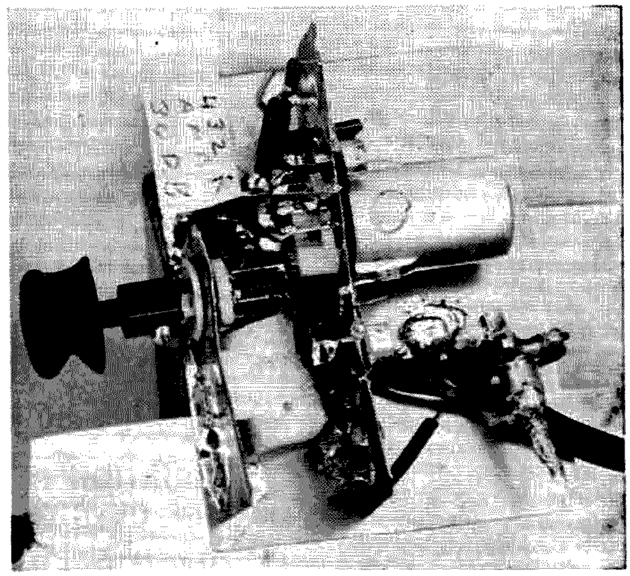
and $R_4 = 1000$ ohms. To solve for the equivalent resistance of the circuit: connect "3" on the R_1 scale with "6" on the R_2 scale. From the point where this line crosses the scale between these two, draw a line to "9" on the R_3 scale. Again, from the point where this line crosses the intermediate scale (R_2 scale) draw a line to "1" on the R_4 scale. The point where this crosses the intermediate scale is the equivalent resistance, which in this case is 0.6. Since each resistance was one thousand times the characteristic number, the equivalent resistance is 600 ohms. If there were more resistors in parallel, we would continue in this manner, always in a counterclockwise direction.

If we were working with series capacitors of values, for example, 3 pf, 6 pf, 9 pf, and 1 pf the result would be 0.6 pf.

Going back to our resistor problem, suppose in addition to the four resistors above, we also had in parallel a 200 ohm resistor. Since this is just like having a 200 ohm resistor in parallel with a 600 ohm equivalent resistor, we simply connect the "6" point on R_1 with the "2" point on R_2 and read off 1.5 or 150 ohms. Doing it takes less time than explaining it.

. . . WA2BWQ

Another RF amplifier for the 432'er in July '64.



RF Amplifier for 432

Bill Hoisington K1CLL
Peterborough, N. H.

Digging hard into the practical possibilities of low-cost amplifier tubes for 432 megacycles, we found (after building an odd ½ dozen or so amplifiers) that well over 20 db gain is possible with a 6AM4 tube at this frequency, with a stable circuit. Including this high gain unit, we are thus describing three 432 megacycle amplifiers using tubes, which should be enough to choose from.

This one, (see Figs. 1 & 2) using a straight ¼ wave line beginning with the grounded end of the plate strap line, through the socket pins, on through the plate structure itself, and ending up with the top of the plate as the hottest to rf (or open end portion of the line), seems to have more gain than the previous one described in which the plate was tapped on to the plate line. You have to be more careful with unwanted grid inductance though, due to the gain. This is the inductance you *don't* want, and that you thought you eliminated by grounding all those five grid pins!

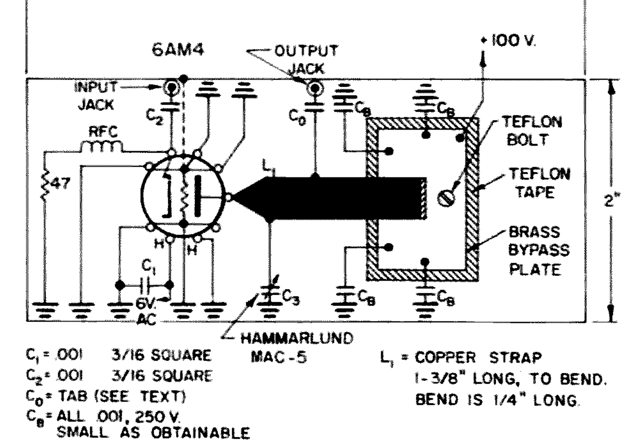


Fig. 1—Front "inside" view of rear wall—high gain 432 mc Amplifier

Also, just as a confirmation of the old warning about bakelite on high frequencies, I built one of these units with a bakelite 9 pin socket. Gain of about 9 db! Ugh! Nuff sed.

It really pays off at 432 to look up and get the thin version of the porcelain sockets. This thin version allows the socket pins to grab the tube pins way up close to the glass.

Note that the plate structure of the tube (to a certain extent) along with the shield of the tube, forms a partial cylindrical cavity for the plate cicruit.

Fig. 1 shows a view of the back wall of the unit. In a sense, everything except the tuning capacitor is referred to the back wall as ground. It is hard enough to find a "ground" at 432 megacycles, so I'm mentioning this one. It is quite efficient also. Items needing such rf reference to ground are: the input jack outer conductor, the five grids, the two heater connections, the rf output jack outer connections, the plate line cold end bypass capacitors, and the tuning capacitor. This last is actually referred to the *front* wall, but that is still OK, if used as shown.

Still talking about grounding, I also used on one of the units a socket which was definitely *not* UHF. It was of good porcelain, but the pins were quite *long*. With everything buttoned down tight I still got feedback oscillation at one spot on the dial (without plate load). With all the five grids grounded, one of them made a loop about an inch long—starting from the wall, up to the pin, and down through the tube base to the actual grid structure. This was enough to cause the feedback. Note (as mentioned before) this is a high gain, high Q job. Operating

without the plate load is, of course, done intentionally in order to *find* the feedback. With the over 20 db gain, this means that one microvolt coming back to the grid circuit (supposedly grounded) can produce over 100 microvolts in the plate, etc., etc. The remedy was to strap over all the grids. Better, of course, is a thin UHF socket.

The results with this amplifier were worth the effort. A good tuning range is obtained with (for this frequency) a large "store-bought" parallel tuning capacitor, running

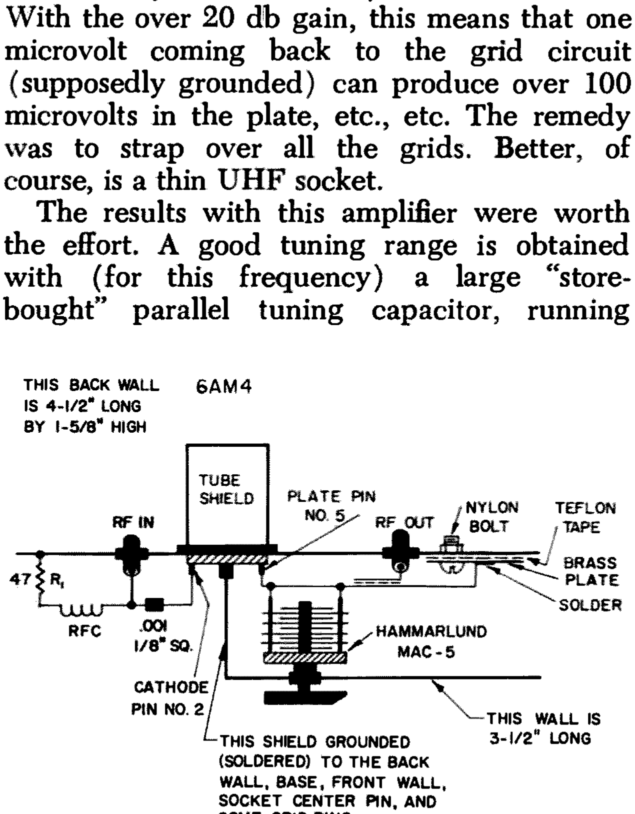


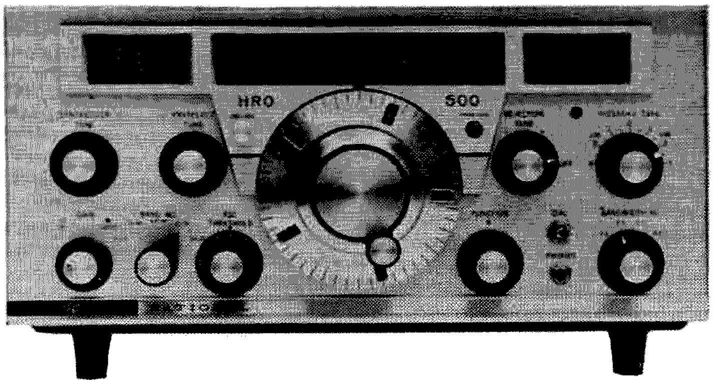
Fig. 2—Top view, 6AM4 high gain wide range 432 mc Amplifier

from under 400 megacycles to over 475. This can be trimmed later if you wish. No oscillation occurs, even with the over 20 db gain. The nice thing about this much gain is that you can throw away some by overcoupling the output circuit if you want to, for greater bandwidth. Co does this. Co is a small copper tab about ½ inch long soldered directly to the output jack center conductor. It lies flat against L1, which has Teflon tape over it at this point, and can be bent closer or further from L1 as needed. This adjustment depends on mixer loading, cable, etc.

The high Q of this circuit should keep out lots of unwanted signals. Don't forget 70 more Tee Vee channels are coming up! And all of them *above* 432!

The plate return or B plus bypassing, has now become a "science" here. A thin brass plate about ¾ inch by one inch is bolted onto the wall, with Teflon between. Then four 1000 mmfd discs are soldered on. These must be the smallest you can get that will take 250 volts, and the leads must be about 1/16 of an inch long. No more!

Just a reminder here of another tube choice, the 6AN4 job, also in 73 Mag. So now you have a choice of three amplifiers for 432. Solid state ones being written up also. More coming. . . . K1CLL



The National HRO-500

Wayne Green W2NSD/1

Perhaps I'm not the best person in the world to test something as expensive as this. When the original HRO came out some thirty-odd years ago I looked at it with awe and longing. By the time I finally could afford one they were just a little out of date . . . about two years ago.

But here I sit, through the kindness of National, with an HRO-500. True, it has to go back, but in the interim I will be able to mention to a few hundred fellows quite casually that, yes, I'm using the 500 here.

The more I use the 500 the more convinced I am that all ham receivers will eventually have to adopt the one kc per division type of tuning. The old HRO had that on some bands . . . as did the NC-101, and it is awfully easy to get used to. Collins cottoned on to this idea too.

The 500, being transistorized, snaps on immediately when you flick the switch. I like that. It gets me on the air a lot more than when I have to turn on my receiver and wait for it to warm up so I can hear what is happening. Perhaps I am more impatient than most people. Of course not only is the warm up period almost instantaneous, so is the warm up drift period. Brings to mind my old SX-28, which used to drift about 50 kc on 20 meters as it warmed up to its task. When I remember that, I guess I'm not quite as furious over the garbage eating W2 that borrowed it one day and proceeded to sell it and pocket the money.

The general coverage receivers that I've used in the past were never quite adequate for optimum ham band usage . . . the 500, which tunes continuously from 5 kc to 30 mc, seems to sacrifice nothing for this flexibility.

The most unusual aspect of the 500 is the frequency synthesizer which permits you to tune any 500 kc segment of the five bandswitching bands. The basic bands are:

0-1.5 mc; 1.5-4.0 mc; 4.0-10 mc; 10-20 mc; 20-30 mc.

As you tune the synthesizer the first numbers of the frequency you are tuning light up over the dial. The PW dial is calibrated to one kc and the 10 kc readings are indicated in the PW windows. By the way, one turn of the outside PW knob equals 10 kc, which makes tuning in QRM a snap, though it gives you a bit of a workout when you swing from one end of the band to the other. I think they said something about twelve feet of bandspread . . . that's about right. The result of all this is that you have sixty bandspread bands you can tune, all with one kc per dial division . . . and, thanks to the synthesizer, you don't have to have sixty crystals to do it.

While the 500 cycle selectivity position is fine for CW and the 2.5 kc position is great for SSB, the receiver does have a 5 kc to 8 kc position for "hi fi" listening or, I suppose, multiplex RTTY or something.

Those of you who have used the 75A4 or the 2A receivers will appreciate the value of the passband tuning on the 500. This is wonderful for SSB and CW work where QRM is a

problem . . . something not altogether foreign to our amateur bands. Another handy gadget when the interference piles up is the "Rejection Tune" control which swings a deep notch (50 db) across the passband for you, removing heterodynes.

The Automatic Gain Control system keeps the output steady within less than 10 db with a variation in input of from 5 to 50,000 microvolts: There is also an adjustment for matching the action of this circuit to various levels of background noise.

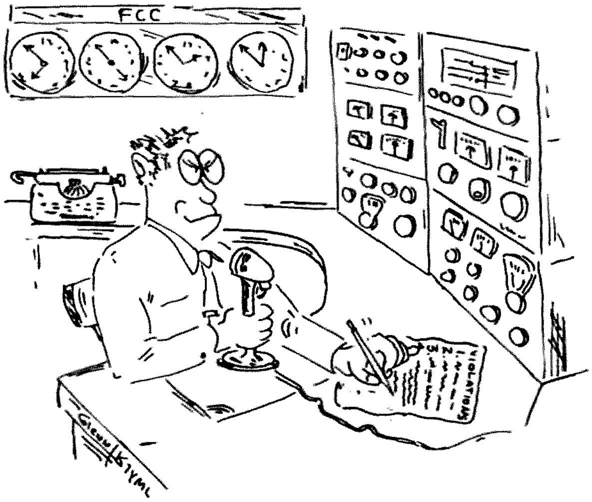
The S-meter is calibrated accurately. Who knows what will happen to us when we can believe S-meters. Imagine the impact on DX stations when you tell them what their signal strength really is! I've been doing this and for some strange reason many of them have taken a second look at their S-meters and lowered my signal reports. Hmmm. Honesty is the best policy and the 500 *is* honest.

Another nice feature of this receiver is that it will operate directly from a 12 volt source if you want to use it in the car or on a trip. The 200 ma that it draws doesn't even strain a small lantern battery . . . imagine, you can get far away from all line noise and hear what a radio should really sound like.

Oh, there are a lot more interesting features to the 500, but if you go out and spend $1300 for a receiver you certainly want to have a few surprises waiting for you.

I dunno who is responsible for making the HRO-500 look so good, but they should get a raise.

. . . W2NSD/1



"OK on this being your 496th skip contact on CB, OM. We do QSL . . . as a matter of fact, I'm making out a card for you right now . . . ."

Letters

Dear Wayne:

In reference to the June issue of the 73 magazine, Letters, portion, many of us of the Yakima Amateur Radio Club, have read the letter from the person who calls himself the Yakima Ham, and wish to state the following:

First, a person who uses such words as hell, you nut, and etc., apparently does not have any other way to express himself.

Second, we feel sure that the said letter would never have been approved by the club, while we may or may not agree with statements you have made in the past.

Third, we strongly feel that anyone who does not have the decency to sign his name to a letter, should not be allowed to have the letter published. As, even in court, the one has the right to face his accuser.

Fourth, to our knowledge, no so called CHECK has been made on your so called charges.

Garrett Derrey W7ZMS, Pres.
Yakima Amateur Radio Club

P.S. This letter has been read and approved by the Board of Directors of the Yakima Amateur Radio Club.

1. Hell nut, etc., are expressive. 2. Thank you. 3. Signed or unsigned the chap who sent the letter has a view which should be considered. 4. Check the "charges" and see if I'm lying. Many others have verified every statement that I have made.

Dear Wayne:

I just don't understand how a person that can put out such a wonderful technical magazine can be so far off base in the field of amateur radio politics! Referring to your June editorial I can agree with only a very few of the points you are trying to make. I do not feel out of line in making these statements because in all my conversations with other hams the majority of them feel the same —i.e., that you are some kind of nut! !

At a recent club meeting there were over 85 members present and Docket 15928 was discussed. There was no hostility to it at all. With two exceptions most people appeared to accept it. The Call Letter changes and Advance Class Downgrading were the only exceptions. They didn't feel like the ARRL had pulled any kind of swindle. From monitoring many QSO's here on the West Coast I get the impression that the greatest majority of the people feel the same way.

Now the question is—are we out here on the West Coast getting an incorrect picture of the overall opinion—or are you indeed "some kind of nut"?

I certainly don't like you to be the spokesman for the group if you are not reflecting the true picture.

Please take stock of this thing again, are you just trying to sell magazines or are you truly doing the best thing for amateur radio?

Ed Munsell W6PCP
Los Angeles, California

Dear Wayne:

I would like to see you champion some CW privileges on one or more of the low bands for Technicians. It seems to me this goes along with increasing the Novice to two years and incentive licensing. Despite the FCC's intent, the Technician license has become an intermediate step to the General. Now it is extremely difficult to improve one's CW (on the air) on the VHF frequencies alone.

John Ott K9AHX
Lafayette, Indiana

John, when someone comes up with a good reason why we should continue the CW test, I might go along with you.

Dear Wayne,

Got to looking at ARRL/QST leadoff idiotorial in April QST. This is probably their April fool item. It does not flatter those that read it. Like "In fact, by the power of his ballot, the member can *require* that his representative take the time and make the effort to become adequately informed as to membership needs and desires."

Like Mort Kahn didn't do for the last few years of his directorship, maybe?

Wonder what you can make out of this:—I wrote Dick Baldwin some time ago and getting a reply was startled to note that he was now "Assistant General Manager." This got me to thinking . . . went thru QST's back to mid year of 63 (I think) and he was still listed in QST as Editor, but not A.G.M. for June QST of said year (June mag going to press sometime in mid-May I reckon) . . . but looking thru later issues found that the switcheroo took place in 2nd half of said year . . . got to looking up the minutes of ARRL Bored of Directors, also Executive Committee minutes (as reported in Q-ST) but no information. Looked up all notes about changes in staff (Parenthetical thought: did you ever notice that they tell of upward changes in their staff, but seldom if ever tell that Joe Blough left to go to work elsewhere?))

Anyway, I looked all around in those "Happenings of the month" and while they reported about some office-clerk going up by half-a-notch, no news about Dick Baldwin and his elevation to AGM. I responded to DB's letter by the way & offered up congrats upon his elevation to heir-apparent status & asked "when did it happen?" but he was mum about this 110%. Hmmm . . . I wonder . . .

Wrote to League a month ago. Said please send annual report (copy or summary) so I can see how we're doing. Got reply as follows: "Dear OM: Enclosed is our statement for 1963. The 1964 one is now in the works, but won't be available until after the annual meeting of the ARRL Board of Directors in May. 73, Gary L. Foskett, W1ECH Assistant Secretary" I responded last week, but I felt that maybe you could put the thought to greater function. I commented, in effect: Thanks, but I still would appreciate a copy of the 1964 annual report. . . . I own stocks in a couple small corporations, belong to a couple of fraternal & charitable organizations, etc. and they all depend upon my interest and confidence in their operations for my continued support. With annual reports coming out in June (After B o D annual meeting & approval, plus trip to printers) when everybody's thinking of vacation, how can the typical Joe Blow League member think intelligently with 6 month old information (even if bona-fide)?? *In short, how can the guys in the League tell the Directors what to do in the year ahead, if the HQ gang says you can't have 64 report until mid-65, after the Board meeting?* In newspaper game, saying sez: "Nothing so dead as YDA's news." So . . . get your hot rreports here fellows, get em 150 to 180 days old!!

Got to thinking, it might be advisable for some righteous-looking member to inquire of ARRL, "Kin I see your contribution books for the new Bldg Fund?" I wonder who these wonderful gentlemen were who promised to pony-up on the 2-for-1 offer. You know, if the ARRL put up 10 K bucks more, the "mystery donor" will put up another 10K. Who could the mystery donors (mystery sponsors) be?? They say he who pays piper calls honorable tune . . .

Firmly believe that your editorial balance is *very good*. I sense (maybe wrong) that the average guy won't take too heavy a diet of criticism, even tho it's 100% right. That's human nature for you. Look what the English people did for Winston Churchill. He did everything right most of the time during WW2, but the British voters still "turned him out" at the polls in '46, or rather the party he headed. Hi.

Believe strongly that your main rock-of-support is in having an excellent technical journal . . . keep the FB technical stuff flowing & you'll see that the readers will not object to your continual fault-pointing!

I apprehend—from reading between the lines—that this must have been your decision already. . . .

Neil Johnson W2OLU
Tappan, New York

ARRL VHF Manual

I just received a long awaited copy of the ARRL *Radio Amateur's V.H.F. Manual* by Ed Tilton W1HDQ. It's quite a bargain—over 325 pages for only $2. The book is written particularly for beginners, so it's perfectly understandable, but contains plenty of interest to the most advanced VHF ham as well. The first part of the book gives a brief history of VHF hamming and a discussion of the capabilities of the VHF bands. Then chapters are devoted to theory and practical construction of receivers, converters, preamps, transmitters, antennas, test equipment, etc. Most of the projects and information in the book are adapted from *QST* articles (In fact, the extensive bibliography doesn't even hint that other electronics magazines exist), but many of the projects are new and interesting. I have a few small criticisms, such as the scarcity of transistor projects and the great amount of space devoted to condensation of the recent *QST* articles on UHF pulse systems in contrast to nothing practical on the simple duplex system that is more likely to appeal to beginners. Antennas seems to be shortchanged, but the 73 *VHF Antenna Handbook* will take care of that for you.

But these are minor criticisms. All in all, it's an excellent book and one that every VHF'er and prospective VHF'er will want to have. The newcomer will find that it contains a tremendous amount of practical information. The old-time will find some new projects, valuable reference and lots of opinions to argue about in time-honored ham fashion.

. . . WA1CCH

". . . and dear, Rodney's been the best little boy. He went into your hamshack three hours ago to play and I haven't heard a peep from him since."

Letter from Gus

Bhutan, June 13, 1965

This is being written on my last day in Bhutan. During the past 5 months I have been into ALL the AC areas. I have had (without counting them exactly) over 30,000 QSO's on this trip, over 5,000 from AC3 and about that same number from AC4. Over 2,500 QSO's from each AC spot. If anyone needed AC spots for a new one I surely hope that they have worked me by now. With the total of something like 20,000 or so QSO on my first stop here a few years ago, the total is now something like 50,000 QSO's from AC lands. I believe I have had more QSO's from AC land than I have had from W4BPD!

I want to tell you of operating here. This is certainly the hardest spot in the world to work the USA. W4 this time was the hardest place to QSO, W8 was second hardest, then the rest (starting with the easiest): W6, W7, VE8, VE7, W2, W1, W3, VE2 and 3, W5, W9, WØ. It was not due to the fact that I was not on the air, you can bet your last buck I was there trying my very best to open up the band. Every day I was on starting at 2300 until 0330, then again at 1100 until 1830 GMT or until the band folded up completely. Boys, it was not ME, it was conditions. I tried my very best to dodge what QRM I could. Those commercial RTTY stations on 14035 and 14065 caused me lots of trouble but I would try and sneak as close to them as possible, usually just below them a kc or two. On this portion of my trip I was stuck with transceive. I altered a transceiver here by adding a small trimmer condenser to it so I could tune about 12 kc below my operating frequency. It worked fairly well, but was NG to work the boys in the USA ssb portion. I did have an old beat-up BC-348 that I had pepped up somewhat and this was used when I worked the ssb boys. The best frequency seemed to be around 14101 or another fair frequency towards the end of my stay was around 14135 to 14140 kc. During the past week or so I have had to stop trying to work the USA boys on ssb because the power transformer went up in smoke in the BC-348. I have found that this 50 cycles gives a regular power transformer a fit. I suppose if the rig I were using was operated as a regular ham would operate it, maybe 3 or 4 hours each day, it would be all OK for a long time. But when you operate each day 4 to 5 hours in the morning and then again 9 to 10 hours every night, and 50 cycles (maybe even 40 cycles—they do this to conserve petrol) then you can expect things really to heat up—and brother they DO. After the first 2 hours you can't hold your hand on the power transformer—I don't see how it takes it. Of course, I turn the rig off everytime I get a chance, even when I say QWC one boys, or gas in putt-putt, or chow time. If turning it off these few minutes cooled it down I certainly could not feel the difference BUT theoretically it should—so I did it every chance. Maybe the one in this rig is fire proof! You should see this poor old Hy Gain model 14AVQ antenna I have. The boys out in Lincoln, Nebraska made this one up specially for me, the maximum length of any portion of it is about 3 feet, with every section slipping into the next section. The spot to stop at on each section was marked with a Markall. This one now has gone up and down I suppose 20 or more times. It's been mounted many different ways, on many different supports: it's had a real beating, let me tell you. Usually the support is a big. bamboo pole about 60 or more meet high. These bamboos when they are green are quite heavy. The people who help me put it up usually cannot speak English, they have had no experience at all in putting up or taking down poles, so about 25% of the time they will let the pole get out of control, especially while taking it down, and then it's slam-bang and the whole works flat on the ground. It's murder to the antenna: it's been bent (a few that will never come out), the traps are pushed in: in other words, it's a MESS, the darn thing still works FB and the SWR is still very, very low. It works a lot better than it looks.

Something I just cannot understand is why at almost every place I operated that it's very easy to work the W2 boys. If you take a map of the world and look at it and place a circle around W2 area and another around the AC area all you have is two small dots on a map. Can anyone explain to me why it was possible to have QSO's with just this W2 area without any difficulty at all, practically every day? Do you think maybe that the W2 boys have a better organized group to hunt the DX and a better system to alert them to the fact that DX is on and coming through on such and such a frequency?

On this trip into the AC lands I got to know the people a lot better and really saw the country. They have lots of strange customs up there. What do you think of trying to chase evil spirits or devils out of a power plant by burning yak butter lamps in each corner of the room: burning all kinds of very bad smelling things all around the power plant and then pounding on the plant itself, then praying to it, sprawling out flat on the floor? Well I have seen this done and many many more such things are done in AC lands. This applies to transmitters and receivers also. After seeing and hearing of such things they begin to get you down and it looks like a lost battle when you are doing your very best to assist them in getting things repaired and in good working condition.

I found a few very fine spots to operate from up there. Take AC8 area. You come into a big wide valley that's about 5 miles wide. Right in its middle there is a hill about 2.500 ft. high with no trees on top at all. You climb up there and then pull out your compass and BOY oh BOY the valley runs exactly NORTH and SOUTH, which is in the exact direction for the USA, either by Short Path or Long Path. There are any number of spots here and there you come across. Well, it's 9N1MM land next fellows, and after that, plans are not definite yet. Sure hope to work you all from every spot even if you don't need it for a NEW ONE! I like lots of QSO's!

. . . Gus

VHF

Bill Smith K CER
1301 Churchill Ave.
Sioux Falls, S. D.

Last month I said that we would look at circular polarized antennas this month. Unfortunately, a heavy work load and never-ending weekend rains have prevented raising the antennas. Will try again next month.

From my participation in the ARRL June VHF contest, it seems that six meters was open for all areas of the country, far different from last year. There should be some excellent scores.

Tropospheric conditions are finally starting to come around in the midwest. The large stationary front which brought rain and devastation by flood waters in Colorado during the third week of June led to the first tropo opening in the midwest since January sixth. Stations in South Dakota and Minnesota worked south to Texas, east to Arkansas and all points in between. K5WXZ, W5AJG and W5JWL put good two meter signals into the upper midwest boosting states-worked totals. The signal levels were not especially strong but they were in for parts of three days. Better start watching the stationary fronts from now until late September.

Sam and Helen Harris (W1BU, W1FZJ, W1HOY) have moved to Arecibo, Puerto Rico, where Sam will be working with the 1000 foot reflector. KP4BPZ was to have been active on 432 mc moonbounce July 3. Another test is scheduled for July 24 beginning at 1110 GMT with a two minute CW CQ on 432.000 mc. The test will last for just over two hours with calls being accepted between 432.010 and 432.1000. SSB may also be tried. No two meter operation is planned. Sam said here in Sioux Falls during the April meeting that he doubted that KP4BPZ would operate on two because of the inconvenience in moving equipment, etc.

On the west coast W6DNG is continuing his 144 mc EME (Earth-Moon-Earth) skeds with OH1NL and UA1DZ. Several of the west coast gang have reported hearing the UA1 calling Bill.

More reports on Oscar III have been received. Oscar is still sending back HI's erraticly as the beacon goes on and off depending on the charge of the solar cells. The Oscar Association still would like your report if you haven't sent it in.

W1QKA and W1DUB in Nashua, N. H., have been running some interesting tests on 2415 mc. They are three miles apart, but have been bouncing CW pulses signals

›ff Pack Monadnock Mountain (2310 feet) for a 48 mile otal path. W1QKA says that the signals were about 30 lb above the noise using modified APG-5's (2C43 oscil- tor) into four foot dishes at both ends. Both also used uperhets with 1N21F mixers, 6CW4 cascode if preamps, odified APG-5 local oscillators, four stage 6AK5 if ımplifiers and threshold detectors a la K1 JIX.

Don't forget to send in your reports on interesting ıctivities.

. . . KφCER

SEMICONDUCTORS

Paul Franson WA1CCH
Peterborough, N. H.

As promised last month, here is a quick look at the most ommon parameters that transistor manufacturers use in ating their transistors:

The maximum voltage that can be applied between lements of a transistor without risk of damage (breakdown oltage):

BV_{CE} Collector to emitter with the base open (not con- ected to anything). Sometimes called BV_{CEO}.

BV_{CES} Collector to emitter with base shorted to the nitter.

BV_{CER} Collector to emitter with a resistor connected om base toemitter.

BV_{CB} Collector to base. Sometimes called BV_{CBO}.

BV_{EB} Maximum reverse voltage from emitter to base.

The *B* standing for breakdown is often omitted if there no possibility for confusion in specifications.

I_C Collector current.

P_T Total transistor power dissipation.

I_{CBO} Current leakage between collector and base with ıe emitter open.

f_{ab} Frequency at which gain in common base configura- on drops to 70.7% of that at a low frequency (usually 1 :.)

f_T Gain-bandwidth product. Frequency at which the ırrent gain drops to one, i.e. no longer amplifies.

f_{MAX} Maximum frequency at which the transistor ıcillates.

Some of these can be a bit tricky unless you know how ı interpret them. Your best bet is to use the specification ıeets that you can get from the manufacturer or distribu- r. These spec sheets give typical circuits, noise figure, ›ssible gain, power outputs, etc., depending on the use e transistor is tended for.

A new RCA transistor of considerable interest is the √3866. It's a silicon NPN triple-diffused planar transis- r which provides considerable power output at VHF ıd UHF with a reasonable price. It will put out as much two watts on two, and one on 432. Even more impor- nt, one watt is possible on two with 18 db of gain. On 2, gain is about 9 db for one watt out. V_{CER} is 55 volts, the 2N3866 is ok for automobile AM service, though s cutting it close. P_T is five watts. Price is only $4.95 ıgly, considerably less than previous transistors with ese specs. Write RCA Electronic Components and de- :es, Commercial Engineering, Section 738, Harrison, . J., for spec sheets on the 2N3866. May as well get e on the 2N3478 while you're at it.

. . . WA1CCH

Continued from p. 4.

that jazz you should ask around a little bit. Perhaps I am more in touch with this than many of you, being an editor, but surely you know that the first working parametric amplifier in the world was built by W1FZJ on six meters. Read Scientific American . . . or read the article I ran in CQ by Sam at the time. Everyone thought it was a humor article . . . imagine, a receiver using a UHF pump oscillator . . . how ridiculous. Another even more recent first was the K2TKN Flying Noise Lock receiver which was a breakthrough in under-the-noise detection. This was in 73 first. Many of K1CLL's UHF techniques are finding their way into commercial applications. The RTTY gang have advanced the design of converters considerably during the last few years and many of the current commercial designs are right out of 73.

When the ITU wanted to conduct a propagation study of the world who did they turn to for facts and reports? The hams, of course. By the way, if you'd like to help with this project just drop a letter to OK1WI, Propagation Study, ITU, Geneva 20, Switzerland.

Have I covered all of our so-called bad points? Isn't it about time that the League stopped poor-mouthing ham radio and spent some time and maybe even a little of our money in promoting us with the FCC? The FCC has no way to get a broad picture of ham radio . . . they get the TVI complaints . . . the petitions . . . the bickering letters . . . the grumbles. Sure, they read about our great work in Alaska. But they don't read about the hundreds of other public services that we accomplish. The FCC doesn't have a news clipping service to let them know all the things we are doing to help all over the country . . . they don't see the hundreds of reports that come into League HQ on our successes. Isn't it about time they got a truer picture of ham radio? Isn't it way past time?

Before we let the FCC make major changes in ham radio we should take the time to see just what is really necessary. Write to the FCC and ask them to extend the filing time on Docket 15928 until January 31, 1966. Let's have some time to work out our own future instead of plunging into massive call changes, new exams for everyone, 20 words per minute, wholesale changes in most of our bands, etc.

I make a motion that Herb Hoover find out what ham radio is like in this day and age and then that he go to Washington and visit the FCC Commissioners and staff and tell them what he has found so we can get out of the trouble we are in. Herb will get to know ham radio by spending about a month on twenty and eighty meters, several hours a day, plus some time on six and two, and don't forget a little 160 and 40. Ten and fifteen probably won't be open much this summer. Now, about 1000 QSO's later, he should zip down to Serrana Bank with WA6WTD who has a license and is looking for company and taste DXing from the DX viewpoint for a few days. Next he should bone up on some technical topic and visit about ten ham clubs giving a technical talk . . . and not the usual apologies for 499 and viva ARRL speeches. Then he should try to grapple with the appliance operators as they pop technical questions at him. A one month subscription to a newspaper clipping service will round out his portfolio and he will be ready to answer every critical question the FCC can ask. By the time he is through 15928 will be in the wastebasket where it belongs.

Things Are Good

Lest we get too wrapped up in our little problems with the FCC that the League has visited upon us, a look at the prospects before us is in order. I think we will get our license problems straightened out all OK . . . so what's cooking elsewise?

432 More and more activity on this band. The advent of low cost front end transistors will, I think, revolutionize this band. Converters that used to cost hundreds of dollars can now be surpassed with inexpensive simple units. I wouldn't be surprised to see some come commercially available for around $20 soon. Add to this the removal of Mr. Moonbounce W1FZJ to Arecibo, which is like giving a kid a job in a candy factory, and I think 432 will be blossoming. The first skeds are for July 3rd and 24th . . . and there will probably be a lot more in the future. The day is here when anyone who wants to work Puerto Rico on 432 can make it using a simple transistor converter, a reasonably sized beam (say 100 elements) and a medium powered transmitter. Now if we could just get a few more hams with 1000 foot dishes around we could have a few more moon contacts.

144 Activity is quite high on this band and sideband activity is growing rapidly. The increasing sunspots will probably bring us a lot more aurora activity this year, which is a real ball on both CW and SSB. It does take a fair antenna for consistent results . . . sixteen elements or more, and 200 watts or better.

50 Tropo is going strong on six meters these days with openings almost every day. From up here in New Hampshire we can s

and talk with the Bahamas, Cuba, every state east of the Mississippi and plenty west of it several days a week. I think we're up close to 45 states already this year. California comes popping through every now and then. And you don't need a lot of power or antenna on six to get through . . . we work too many Sixers to believe that. Not that high power and a good beam don't get you in there first every time. It's nice not to miss anything coming through and a five or ten element beam with 200 or so watts will rarely miss.

28 Sunspots are perking things up on ten and some good DX has been popping up. This band will be hot quite a bit this fall so you would be prudent to be set for it with at least three elements and sideband.

21 Activity is high on fifteen already, with several rare DX stations coming through only on this band. If you don't like to fight the QRM you can often have nice DX contacts on this band.

14 More and more twenty is staying open all night. Despite all the gripes about QRM and everything, this isn't that much of a problem if you don't insist on operating during the peak activity hours. Anyone with a three element beam and a sturdy sideband signal can work his 100 countries during a two week vacation. Conditions are going to nothing but improve on this band for the next few years.

Thanks Vote

If we are able to fight off 15928 all of you who sat by and let this happen to you without a whimper owe a lot to the few hundred hams who took the time and trouble to file their comments with the FCC and to complain to Senator Magnuson and Chairman Henry of the FCC. It should have been thousands. Fellows, stop waiting for someone to come to your door with a petition you can sign and write at least one lousy letter telling the FCC, Washington 25. D.C. that you personally think their proposals are preposterous.

Field Day

Luckily for me I didn't get into the Field Day contest until quite late, otherwise I might have gotten hooked into seeing it through. As it was I made 301 contacts in 300 minutes, including one new country (FP8CK) and a VK. Judging from the activity I found on 20 meterphone . . . the only band I tried . . . interest was high this year in this contest. Good show. Activity was widespread too . . . outside of the states too close in for 20 during the day I worked everything except Idaho. Hmm, maybe I'll go in the Sweepstakes Contest this fall.

Maryland VHF Society

This is a swinging outfit down Baltimore way. They were kind enough to invite me down for their annual Dinner in May and even gave me an opportunity to air my views on VHF as well as our current crisis. I tried to talk more of them into big arrays and kilowatts so I could get to talk with them from up in New Hampshire. VHF'ers around that area would do well to drop a line to Box 8554 in Baltimore and join up.

Good Idea

XE1NNN has been sending QSL cards to ham manufacturers that are not advertising in 73 telling them that his subscriptions to the other magazines have run out and if they want to reach him it has to be through 73. Olé!

Fame and Fortune Available

Fame, anyway. 73 still needs someone to take over as Advertising Manager. Salary details are classified, but the take should run around $8-10G as a starter and maybe double that eventually. Advantages? Well, you get to live where it is so wonderful that people come as a vacation both summer and winter (as well as spring and fall). Prices are reasonable, taxes as low as they come, and the people are wonderful. Hamming is great up here too.

We need someone who is a good talker, presentable, educated, intelligent, has a good background in ham radio and sales, has initiative and who is looking for a job that will allow him to grow. He should be making around $10G right now, at least.

Write, if you think we need you.

Lobby Group Formed

The National Association of Business and Educational Radio (Naber) just recently formed. They want more frequencies. From offices in Chicago and Washington, D. C., this association of two-way radio users will seek representation in FCC rule-making procedures and attempt to provide representation on Government/Industry committees relating to two way communication. Where, in a spectrum already crowded, will they get them? They already got our 11-meter band. Will they take more?

Only one amateur radio groups exists that can deal with Congress and lobby for amateur radio: the Institute of Amateur Radio. The ARRL can't do it, the law prevents; should they try, they face heavy fines. (They would first need proper certification which they surely can't get with their present organization). Re

member, organized pressure brings results. Join the IoAR. Don't let a recently formed Citizen group beat our sixty-five-year-old amateur radio hobby out of more frequencies.

The Institute takes your problems right to Congress. You need the Institute's *voice*; the Institute needs your *support*. A mere membership fee of $5 a year satisfies both. Naber charges $15 per first base station plus $10 for each additional base station per member per year. But even at the price, 4000 joined before lanned promotion started just from word-of-mouth and phone calls. When promotion starts, hey expect the total to swell to 30,000. Unless he members of the Institute campaign harder o recruit more members, Naber will get the new frequencies. Get the population up! *Our frequencies need protection.* Naber predicts over a million transmitters by the end of '69.

Moonbounce

Now that Sam W1FZJ is in residence down at Arecibo Puerto Rico it was only natural hat he would tune up that 1000 foot 56 db lish on 432 now and then. The first test came on July 3rd and was remarkably successful. Sam started out on CW, went to SSB, and stayed on SSB for about an hour and then finished up on CW again. The following contacts were reported for the first hour or so of he marathon: W1BU, W1HIV, W3SDZ, B9RG, W9GAB, DL3YBA, K1IGY/1, G3-LTF, WA4BYR, W7ORG, W9HGE, W8TYY, OZ8EME, W2CCY, W4HHK, W1OUN/1, W7AUB, DJ4AUD, W1HGT, W2ROP, K2-CBA, K3GYF, K6MIO, K2MBA, K1SDX/1, LX1SI, W1OOP . . . etc. Worked on two way ideband were HB9RG, W1BU, G3LTF, WA-4BYR.

There were an awful lot of fellows that idn't make the hop . . . fellows that were hearing Sam fine. The problem is the same as was with Oscar . . . signals fading up and own by 20 db or so, and terrific QRM. Sam ggests that those without dishes get out of e low end QRM bin and spread out a bit. Drop him a line and tell him what frequency you are using so he can look for you and will know from even a fragment of your call who he is hearing. This will speed things up tremendously. The next test is July 24th, so get ght at it. W1OOP worked through with a 4 element colinear and 200 watts, but this is a minimum. The signals from the dishes stood ut like sore thumbs on the band and everyone else was in there, fading in and out, with weak signals.

I'm planning on being on the Arecibo end r the 24th test . . . say hello.

That Building Fund

Many amateurs felt that the League had sort of given them a kick in the . . . er . . . teeth with RM-499 and its resultant Docket 15928 and quite a few have expressed to me their regret over having contributed to the ARRL Building Fund. A letter from John Huntoon says, "As participation in the Building Fund Drive is purely a voluntary matter, under no circumstances would we want any contributor to be dissatisfied with his action. Accordingly, I am enclosing our check for $2.00 in refund of your donation." In another letter John writes, "I repeat I would not want to have any part of our Building Fund made up of contributions from people who have regretted their actions." These letters were forwarded to me along with the refund checks endorsed over to the Institute.

This certainly is a very commendable thing, though the refunds may get out of hand.

73 Hamfest

How many do you expect, they kept asking me. I have no way to guess, I'd reply. Probably be over a hundred and it might run to a thousand. Well, we counted a little over 1200! Pretty good for a little hamfest way up in the mountains of New Hampshire, eh?

Scattered showers on the third cooled us off and gave us a bright shining clean New Hampshire on the 4th of July with magnificent visibility from the mountains.

Among the events to keep people busy during the day we had a two meter transmitter hunt, an antenna measuring contest for both 144 and 432 mc, a home brew contest, exhibits of manufacturers, twelve tables of bargains spread out to browse over, and an auction that lasted a good part of the day and sold over $30,000 worth of equipment! All sorts of home brew and commercial gear went, from an NCX-3 on down to 25c grab bags. We had about an hour discussion of Docket 15928. A great many took out an hour or so and visited the 73 headquarters building and the 73 mountain ham shack.

Bill Hoisington K1CLL was on hand to show off his home brew UHF gear and mc the antenna measuring contest. Bill did a splendid job and the winner of the contest was Jud K2CBA with a 432 mc colinear.

There was a considerable clamor for us to have another hamfest next year. I wouldn't be surprised if we did. If anyone didn't have a good time, I didn't hear about it.

. . . Wayne

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CONVERTERS $10 and up. World's largest selection of frequencies. Ham TV vidicon cameras and parts at low factory-direct prices. See them all now in our full page ad in this issue. Vanguard Labs, 190-48 99th Ave., Hollis, N. Y. 11423.

YOUR CALL LETTERS and name in gold, on your very own coffee mug. $2.00 (helps me through college). Latterman K7ZOV, 2511 N. 68th Street, Scottsdale, Arizona.

TOOOOOBES, TRANSMITTING-SPECIAL PURPOSE, New, Boxed, Guaranteed....6CW4 — $1.40, 6146B — $4.75, 417A — $3.95, 826 — $6.90....Free Catalog....Vanbar Dist. Box 444, Stirling, N. J. 07980.

DUMMY LOAD, 50 ohms. All bands up to legal limit. Size, 3 x 4 x 7. Coax connector. Kit $7.75, wired $9.75 pp. Ham Kits. Bx 175, Cranford, N. J.

NORTH ALABAMA HAMFEST sponsored by the Huntsville ARC, Community Center in Big Spring Park on Sunday August 15. Contact William Probus WA4DBQ 2607 Woodview Drive, SE, Huntsville for more information.

SCARA HAMFEST Sunday August 29th at Lake Lenape Park, Mays Landing, New Jersey. Get more dope from Charles Bengal W2TUR, 815 Seaside Avenue Absecon, N. J.

SIX METER MOBILEER HAMFEST. Sunday August 8, Weymouth Fairgrounds, Weymouth, Mass. More info from P. O. Box 94, Wollaton, Mass.

HENDERSON ARC HAMFEST: Sunday August 8 at the Audubon Raceway Park, Henderson, Kentucky. You can find out more from Larry Yates WA4PMA, P. O. Box 83, Henderson.

DELAWARE HAMFEST. August 15, Harrington, Delaware. Write Pete Robinson K3OCI, 304 Kesselring Ave., Dover, Del.

WARREN ARA HAMFEST. Sunday August 29th, Newton Falls Community Center, Newton Falls, Ohio. Get more information from K8BXT.

DRAKE 2B RECEIVER, 2BQ Q Multiplier, 2AC calibrator, Knight V-66 VFO. All excellent, all for $200 Brian Kassel K3LSB, 976 South Hills Blvd., Pottstown Pa.

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PH565 HAM-TV camera converted and airtested UHF onverter included $65.00 prepaid. Al Johnson, K7VQI 018 E. Cooper Street, Tucson, Ariz. 85711

TOROID BALUN KITS—2" core & #14 Formvar. 4:1 r 1:1 Z ratio. Handles Kilowatt. $5 plus 25c postage. Ami-Tron, 12033 Otsego St., North Hollywood, Calif.

SCHEMATICS of surplus electronics, ham gear, and test quipment. Send dime or stamps for list to Hill Enterrises, RD #1, Box 241, Kingtown, Pa. 17967

BRT14 SYNTHESIZER MODULES . . . . UNIT 11C ıow available . . . Also Units 6, 8, 9, 10, 11A, 11B. All New, Less tubes, With Schematic . . . $8.00 each or any hree $6.50 each. Also schematics any unit, one thru welve, Fifty cents, or full set of Fourteen $3.00 . . . RITCO Box 156, Annandale, Virginia.

VANTED: All types, Military, Commercial, Airborne, Ground, Electronic items—Testsets, GRC, PRC, Collins, Bendix, Others . . . We Pay Freight . . . RITCO Box 56, Annandale, Virginia.

VANTED Hy-Gain 18-HT Vertical. Have 14-AVS Verical and TH-3 10-15-20 beam for sale. WAφEJF. Box 41, Cedar Rapids, Iowa.

COLLINS 75-A-4 OWNERS: Don't trade up! Investiate our conversion that makes the 75-A-4 a real dream. V2VCZ—30 Pitcairn Ave., Ho-Ho-Kus, N. J. 201-652-494.

IAVY TCS transmitter, receiver, 115 volt power supply, 'TT microphone, loading coil, and extra tubes $85.00 'OB. Model 15 teletype very good condx $70.00 FOB. Robert N. Hogaboam WB6KNN, 374 Elder Ave., Imerial Beach, Calif.

DX-60 Perfect unused. Estate of W1QJ. FB 2nd rig, k for new ham. $60 plus shipping. W1KSB Cushing, Bickford Rd., Malden, Mass. 02148

IANGING 'EM UP. Complete Collins Station for sale. 5S-3, 32S-3, 30L-1, 312B-4, 516F-2 all Rack Mounted in Collins rack mounts, on 61 inch Bud Deluxe Relay Rack ith Trans-Aire Blower Mounted in top. Complete KW ation will roll right in closet. Not just good, but the st. A $2400 value. Best offer over $1800. F.O.B. Also CWM-2, MP-1, PM-2, CC-2, 351D-2, $1050. J. B. Holmes, Jr., P. O. Box 36146, Houston, Texas 77036.

IGGEST, Nope. BEST? Heck yes! Warren ARA amfest, Aug. 29. Newton Falls. Arrows from Rt. 534, urnpike Warren Exit 14. Details: WARA Hamfest, Box 9, Warren, Ohio.

20 MC. EQUIPMENT, ERCO AM Xmitter/Mod. 6252 al $70.00, R-48/TRC-8 receiver AC, converted to 220 M $30.00. W1HMT, 25 W. Union St., Goffstown, N. H.

HEATH 1 watt CB handy-talkies, model GW-52, prossionally wired, rechargeable batteries, channel 3, excelnt, $125.00/pair. I. Gray, 25 W. Union St., Goffstown, . H.

ORIA HAMFEST September 19, Exposition Gardens, oria Area Amateur Radio Club, advance registration .00 until Sept. 11. Ferrel Lytle, W9DHE, 419 Stonegate d., Peoria, Illinois

BE-33 very little use, guaranteed to look and operate ke new, with manual and cables, $200. Stan Flegler 8RPA, 1400 Poxson, Lansing, Mich., 48910.

LLINS 75A2 $160, National NC-183D $100, Johnson nger I $60. This gear requires minor repairs but is ean. We box, you pay shipping. WφEBE Memorial, outhwest Missouri Amateur Radio Club Inc., P. O. Box 1, Springfield, Missouri 65801

E TS-47/APR, see June "73", VG $40. Two T23/AR-Xmtr (2-832A's) new $14. ea., both $24.00 FOB, G. wick, 26 Ridge Rd., Smithtown, N. Y.

LD Mine. See 73, June 1965 page 78. R105/ARR15—5. Brand new M19 RTTY. $225. I-193 Polar Relay Test et, see CQ May 1965 p. 66, $14. Loop supply for M15 .50. All FOB Maywood. Send SASE for list of other uff. J. Cooper, W2BVE, 834 Palmer Ave., Maywood, . J.

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ANNUAL NETTERS PICNIC Frantz Grove, Nev Ringgold, Pa. Sunday July 25. K3YVG can give you mor information.

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More Letters

Dear Wayne:

I have been an avid reader of your magazine for the past two years. Technically, it cannot be surpassed. However, it has just occurred to me that seldom is any mention made of the important role that our hobby may play in our everyday family relationships. I would assume that there are just as many "rig widows" as "golf widows."

With the above thought in mind, I thought your readers might be interested in the program our local mobile radio group initiated. Each month, of course, we had our usual business meeting. However, the following weekend was our "family" meeting; in other words, a road trip with our families.

Scenic Arizona has many educational and historical landmarks, and we had no difficulty deciding where to go. We have many one-day trips to places such as Miami, where there is open pit mining for copper, to Globe to "dig" for "Apache Tears" (Obsidian), to Colossal Cave, the only cave in the U. S. where the temperature always remains at 73°. Also, there were several overnight camping trips to such places as Grand Canyon, Tombstone, etc. When mobile to and from these sites, we were in direct communication with one another by our rigs.

We found these trips not only valuable from a technical standpoint, but also, it acquainted the XYL with what we were doing and why we enjoyed doing it. It brought families closer together because we shared a hobby; we enjoyed being out in the woods, the mountains, the desert, wherever the road led us.

Our Club feels that our mobile cavalcades have brought the family more closely together, and that our hobby now is better accepted by our XYL.

Alex J. Kenwright K7JNY
Mesa, Arizona

Dear Wayne:

Please advise if an IoAR cut is available for imprinting on my QSL cards. My present card which bears the insignia of another amateur organization has suddenly become obsolete!

George Firmin WA4FSK
Atlanta, Georgia

Yes indeed George. The IoAR cut is available for only $1.

Dear Wayne,

Just read your April 1965 editorial. I want to add my name to that long list of people who never received payment for articles printed in ham magazines. My case was an article published in CQ in October 1957, the title was All Band Mobile (Almost). It was a very poor article, but CQ printed it and I never received any payment. I really enjoy your 73 magazine and I would really enjoy visiting you this summer and seeing 73 Mountain, etc. Hope I can.

L. L. Chilton W5THI
Fort Worth, Texas

Doc, I checked my records. Your article was in October 1958 and I had you down for $16.00 in payment for it. I'm sorry you never received your money, but that was up to the bookkeeper and the publisher.

Wayne:

June was a very good issue. In this day of commercial rigs it is about time that a magazine has the foresight to encourage the use of surplus equipment. The FCC proposal might not have been if more ham magazines published information on home-brew and surplus conversions. More power to you and your convictions, there are lots of hams behind you. A check will soon follow for the Institute. I have one thing to say about the FCC proposal: one cannot legislate incentive!

Jack Swords WA6WTH
Fresno, California

BACK ISSUES AND OTHER JUNK

PRICE INCREASE

Due to the rising cost of printing, postage, salaries, rent, heat, electricity, water, food, property taxes, etc., the cost of individual copies of 73 has been increased effective with this issue to 50c. Notice that that is $6 per year if you buy 73 at the newsstand or parts distributor (not including sales tax). Subscriptions are still only $4 per year (no sales tax). Why pay 50% more for each copy? Subscribe.

73, Peterborough, N. H. 03458

INDEX TO ADVERTISERS

Propagation Chart

August 1965

J. H. Nelson

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MEXICO	14	14	7	7	7	7	7	7	7*	14	14	14
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ENGLAND	7*	7	7	7	7	7	7#	14#	14	14	14	14
HAWAII	14	21	21	14	7*	7	7	7	14	14	14	14
INDIA	14	14	14	7#	7#	7#	7#	7#	14#	14	14	14
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MEXICO	14	14	7	7	7	7	7	7	7*	14	14	14
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PUERTO RICO	14	14	7*	7	7	7	7	14	14	14	14	14
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Very difficult circuit this hour.
* Next higher frequency may be useful this hour

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Fair: 9-14, 16-19, 23, 24, 28
Poor: 7, 8, 15, 20-22
VHF DX: 4-7, 13-15, 22-26

September 1965
for 50¢ plain

73

amateur radio

73 Magazine

Vayne Green W2NSD/1
ditor & Publisher

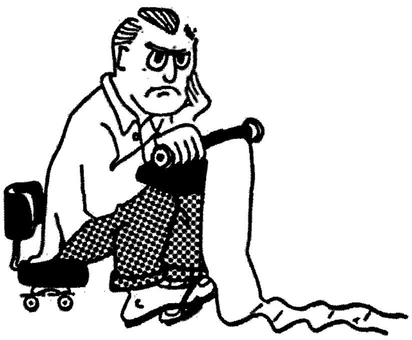
aul Franson WA1CCH
ıssistant Editor

eptember, 1965

'ol. XXXV, No. 1

73 Magazine is published monthly (thank heavens it's not weekly) by 73, Inc., Peterborough, N. H. Zip 03458 (terrible number). The phone is 603-924-3873. Subscription rates $4.00 per year, $7.00 two years, $10 three years world wide. Second class postage is paid at Peterborough, New Hampshire and at additional mailing offices. Printed in Bristol, Conn., U.S.A.

Postmasters, please send form 3579 to Good Old 73 Magazine, Peterborough, New Hampshire. Use your Zip Zone and save our shirt.



de W2NSD/1

never say die

Brand X Raises Price

The July issue of CQ came out so late I didn't have it before our August issue went to press so I could good naturedly rib them about their last-ditch-desperate-when-all-else-fails move of increasing the price of the magazine. Actually August would have been a difficult time to make any sarcastic remarks because we raised the cover price of 73 to 50¢ that month ourselves. We raised the newsstand price to 50¢ a couple years back, but had kept the price at radio distributors at 40¢ since that worked out fine for us. Then our printer sent a truckload of 40¢ copies up to our Canadian newsstand distributor by mistake and that made an awful mess. I figured it was about time to stop the nonsense and make all the copies 50¢ and be done with it.

CQ might do better if they invested in a smart publisher who kept costs down instead of pleading helplessness over the rising costs of paper, printing, postage, labor, taxes, engravings and general overhead. Baloney. If there is any rise in the costs of paper I haven't seen it. We're using a lot better stock than either of the other magazines and we have managed to cut our paper costs almost yearly by shrewd shopping around. By working with printers that are set up to handle our magazine we have been able to cut our printing costs considerably and we are now planning on running 128 pages per month most of the time in the future as a result of our recent change to a printer better able to handle the larger run our increased circulation has made necessary.

Postage has been going up, I'll grant, but the increase has been miniscule. Taxes? Only when you are making a profit, fellows. No profit, no taxes, so where is the problem? We are paying the same for our engravings that we paid five years ago and there is no hint of any increase . . . and if an increase does come along I believe that we can find a half dozen engravers to work at our present price. Labor? Sure, if I had a bunch of high priced dunderheads sitting around here on permanent vacation or out on a 56 foot yacht on Long Island Sound paid for by the magazine I would cry about labor costs too.

Perhaps I should increase our cover price to 75¢ and out-yacht CQ . . . hi. Shucks, at the rate things are going around here I could add a small plane to that.

HQ Instructions

Here I go, picking on ARRL again. This time I just want to pass along some information sent in by an SCM who has been rather frustrated in trying to report the reactions to "incentive licensing" in his area to his Division Director and ARRL HQ. The answer he received from his Director was that he wasn't supposed to get advice from the members, just bring them into line. Get into line fellows, and do as you are told.

IARC Convention in Geneva

The International Amateur Radio Club, an organization formed primarily to demonstrate amateur radio to delegates attending ITU meetings, has announced that it will have a convention on September 18th and 19th at Geneva. This is an excellent time of the year and a good excuse to get over to Europe . . . particularly to Switzerland. In addition to the usual technical papers, meetings with well known DX amateurs, and general confab, you will have an opportunity to operate the six ham stations which will be on the air around the clock for the two days on all bands as 4U1ITU through 4U6ITU. If you haven't tried DX operating here is a chance with the tops in gear and a great location.

Drop a line to IARC, Box 6, 1112 Geneva 20, Switzerland for more info.

Say You Saw It

A good friend of 73 who works for a major ham manufacturer points out that all too many of you who send for information on new products don't give credit to 73 in your letter or card. While I do hope that you'll always mention 73 when you write for literature, it seems to me that it might just be fun to credit 73 no matter where you saw the ad . . . I can just see them trying to find their ad in an issue of 73 after a dozen or so amateurs write in saying they are answering their ad in 73. Heh.

Station Operator Jazz

The recent FCC decision that the operator of an amateur station must use his own call unless the licensee is in actual control of the station as discussed in my February editorial will have an interesting effect on some of our DX hunters. From now on they will have to be on hand to work their own DX and not be able to depend upon a friend to come in and hook a rare one when he is away. Even worse, fellows on DXpeditions won't be able to work their own station and they'll end up being the only one not working the rare one. This could put quite a crimp in DXpeditions.

Many of us are watching QST with interest to see how long the ARRL general manager is going to wait before telling the members about the new interpretation of the rules.

IQ Test

Here's a little IQ test which takes less than a minute. First, read the following sentence,

FINISHED FILES ARE THE RESULTS OF YEARS OF SCIENTIFIC STUDY COMBINED WITH THE EXPERIENCE OF YEARS.

Now count the number of "F" 's in the sentence. Count them out loud. Count them only once, then check your answer at the bottom of this page.

New Trophy

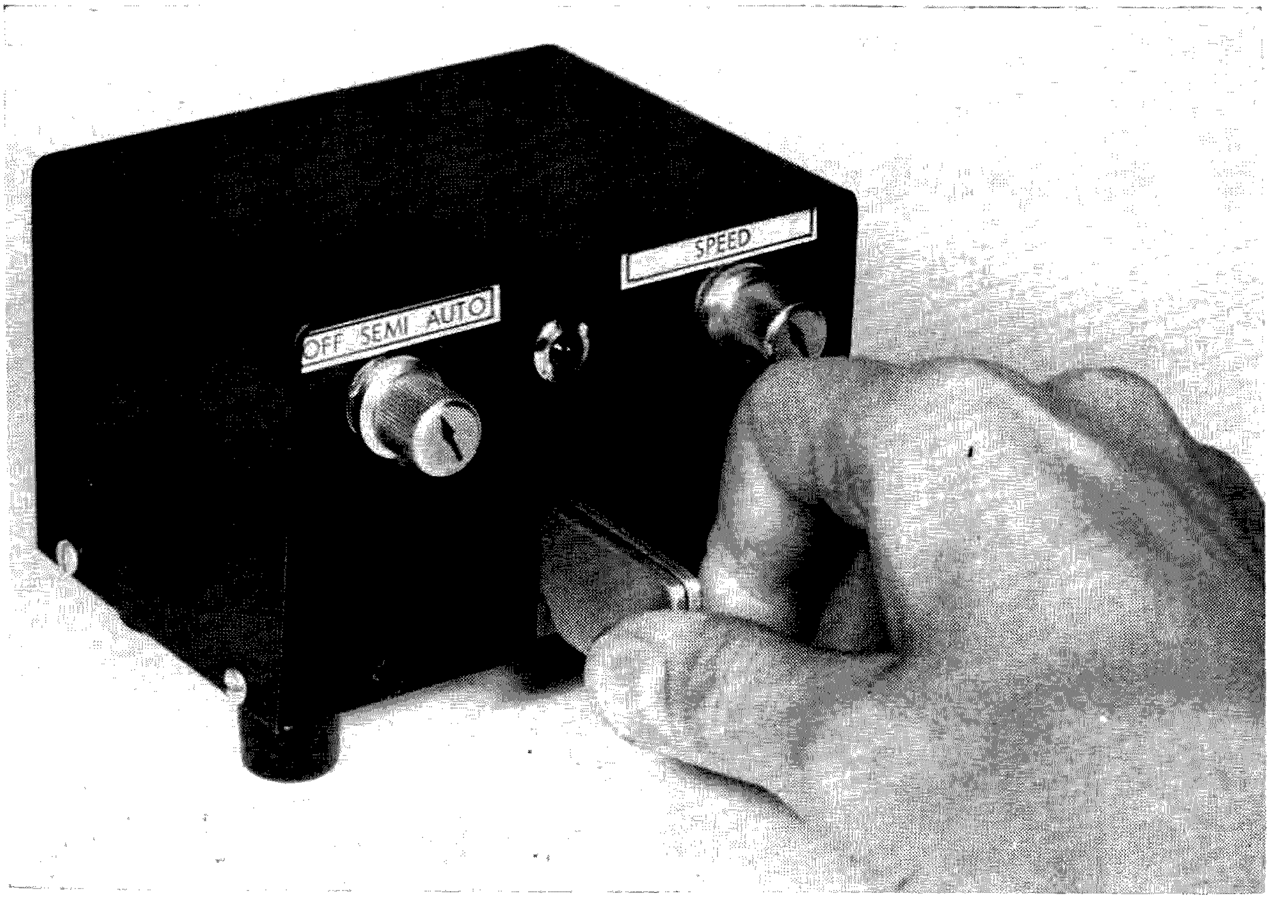
Nominations are now in order for a brand new amateur radio award, the Benedict Arnold Trophy. This handsome trophy will be awarded whenever needed to those amateurs who have placed self-interest sufficiently far enough ahead of the common good to attract national interest in their shame.

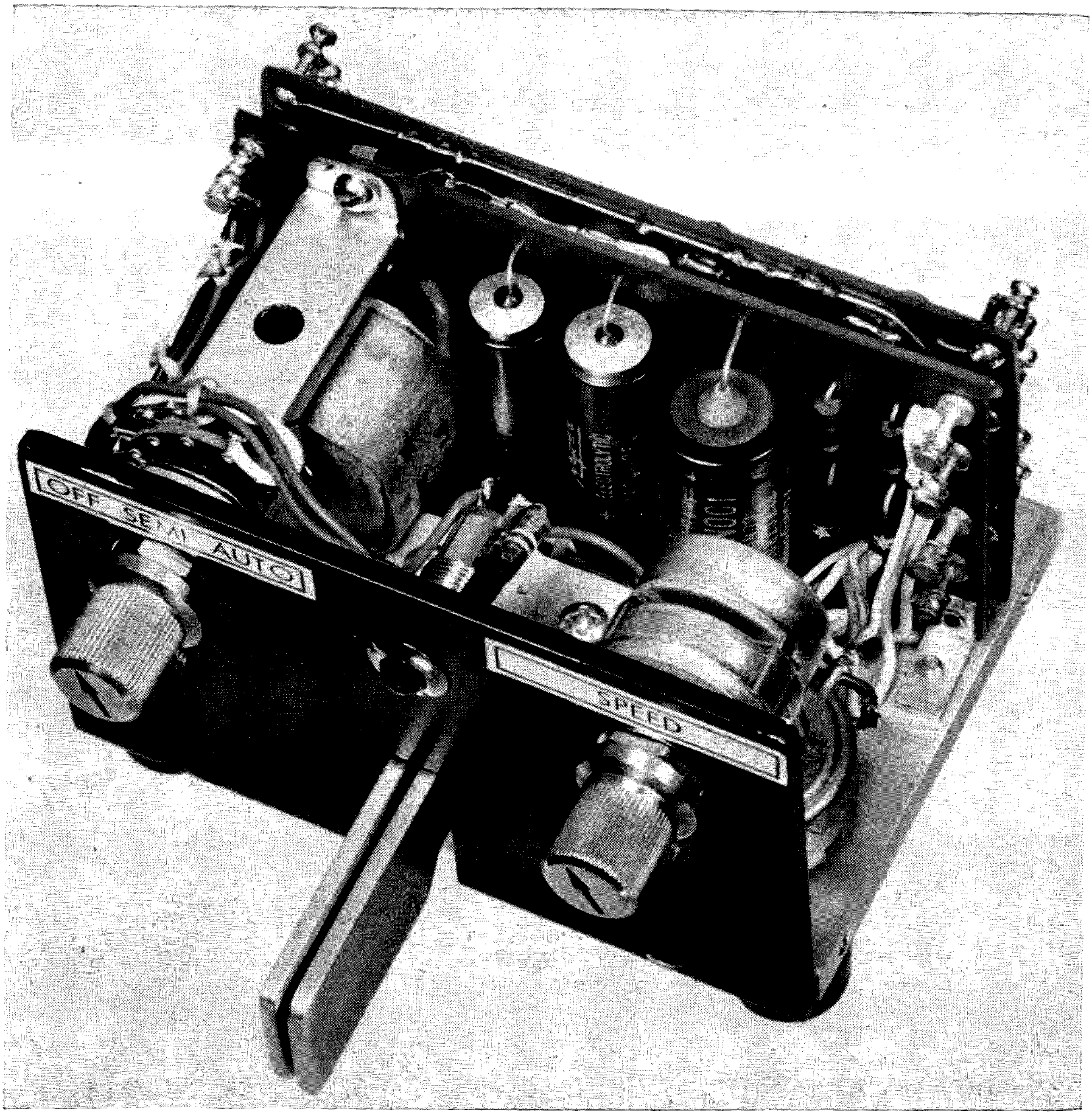
IQ test answer. There are six F's in the sentence. The average reader finds three; above average four. Welcome to the dunce club?

. . . Wayne

E. L. Klein W4UHN/WB2PKE
2501 Chestnut Lane
Riverton, New Jersey

Der Kleiner Keyer





Have you ever wished you had a CW keyer that would automatically make perfect dots and dashes? Here is your opportunity to make just such a keyer, using modern digital computer transistor circuits. Capable of speeds from 10 to 50 words per minute, Der Kleiner Keyer automatically generates dots and spaces which are of identical duration; and dashes which are exactly as long as three dots. And how is all this magic performed?

An explanation of the switching logic

To achieve an undertsanding of just how our transistors function to produce this precise spacing and timing, let us refer to the Logic Diagram of the Keyer, **Fig. 1** and the pulse diagram in **Fig. 2.**

Basic circuits in the Keyer are the *multivibrator, flip flop* and *nor gate*. Added to these are three additional switching or amplifying stages whose only purpose is to obtain isolation and current gain and may therefore be temporarily disregarded for the sake of our explanation.

When the keyer mechanism is moved to the dot position, negative six volts on the base of transistor Q3 causes the multivibrator to turn on, producing a series of positive-going pulses as long as the key is closed. This negative voltage also inhibits the flip flop preventing its operation, so that only dots are present at the driver transistor Q6 and output switching transistor, Q7. Further, once a dot pulse has been initiated and is present at the output of Q6, it is fed back to the base of Q3 and en-

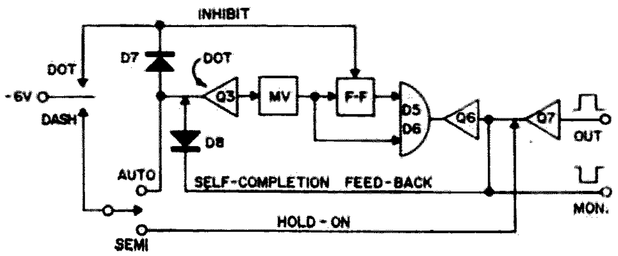


Fig. 1. Logic diagram of Der Kleiner Keyer.

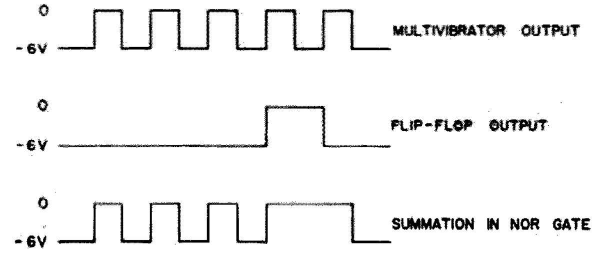


Fig. 2. Digital logic in producing the letter "V".

sures completion of the individual pulse. Operator error is thereby corrected to some extent.

Now, if the keyer mechanism is moved to the dash side, and we are operating in the semi-automatic mode, we find the negative six volts impressed directly on the base of Q7, causing it to be held on so long as the key is down. In this mode, our keyer is like a bug" which is in fact a semi-automatic keyer.

In the automatic mode, the negative six volts is again present at the base of Q3 causing it to turn on the multivibrator. Now, however, the negative inhibit voltage is not present at the flip flop due to its being blocked by the dot diode, D7.

Being thus uninhibited and having the characteristic of being triggered alternately on and off by succeeding positive going pulses only, we find that our flip flop will actually count. In other words, the flip flop produces one positive pulse for every two positive dot pulses. The digital logic diagram, **Fig. 2** illustrates this relationship. Going one step further, we may add these positive pulses from the multivibrator and flip flop by the use of the nor gate, diodes D5 and D6.

Thus we find that the output of the nor gate provides a dash exactly three times as long in duration as a dot. What could be more convenient in the design of our keyer?

A quick look at the circuit

Fig. 3 is the complete circuit for the keyer including power supply. The principal components described in the foregoing switching logic discussion may be readily identified. The 150k bias resistors connected to the base of each transistor provide an adequate positive voltage which effectively cuts-off the PNP type transistors. Due to the much higher resistance of this bias resistor than that of the respective coupling resistor or diode, any negative pulses will take precedence at the base of the tran-

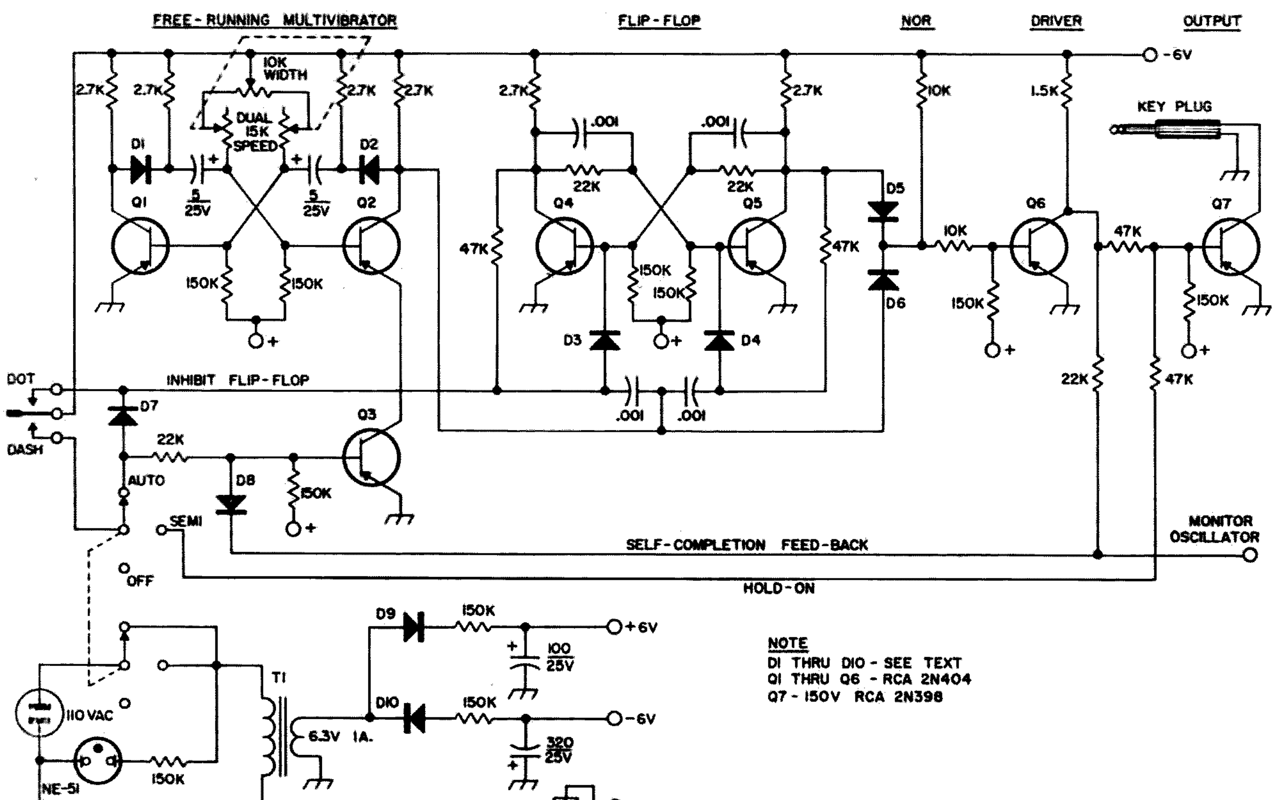


Fig. 3. Schematic diagram of Der Keyer.

sistor and cause the transistor to conduct.

The ratio of dot spacing to duration is set by the 10k potentiometer in the negative supply to the multivibrator. This control is adjusted only once, preferably by aid of an oscilloscope and need not again be adjusted.

Keying speed is determined by the dual 15k potentiometers and the two 5 µf miniature electrolytic capacitors in the multivibrator. As has been shown earlier, only the dots need be controlled, because the dashes automatically are timed by the dots through the counting action of the flip flop and adding action of the nor gate. The value of timing potentiometers and capacitors may be changed within reason remembering the relationship, T = RC. A nonlinear dual potentiometer such as one having an audio taper should not be used because it will tend to crowd the faster speeds making difficult adjustment.

Inexpensive components throughout

All transistors used in the keyer except the output transistor, are inexpensive general purpose audio transistors or surplus computer switching units. The RCA 2N404 is excellent for this purpose, and currently sells for only 35¢. The output transistor is an RCA 2N398B. Although the A" suffix or no suffix at all may be used, we find that for only an additional 20¢, our emitter to collector voltage can be increased by 50% to 150 volts. This safety margin is completely worthwhile when using a nominal minus 100 volt transmitter bias supply. If transistors of dubious genesis are used in the keyer, a little care in matching up their forward and reverse resistance will prove valuable. Of course, a beta checker is desirable, but a simple check on an ohmeter will go far in keeping you from wishing you had used sockets for your questionable transistors.

It is essential that good quality silicon diodes be used. These are quite readily available in bargain packages of 10 for 88¢. Be sure you do not install the diodes with mechanical

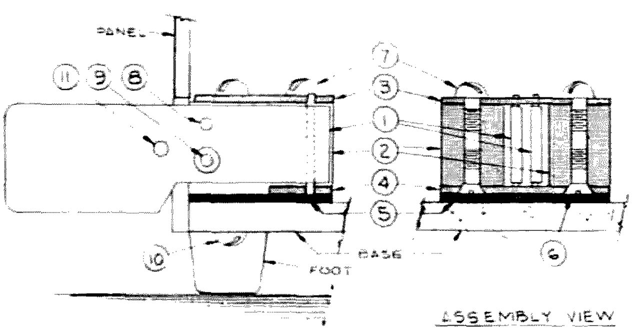
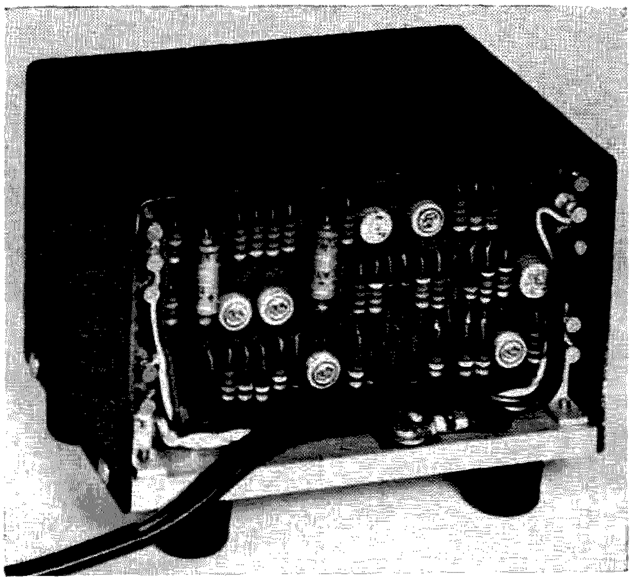


Fig. 4. Assembly of keyer mechanism.



stresses in their leads, and do heat sink them when soldering, in keeping with good semiconductor practice.

Transformer T1 is an inexpensive (75¢) miniature 6.3 volt filament transformer. Taking the plus and minus six volts from the same transformer winding results in a somewhat higher plus voltage (6.3V. × 1.4 = 8.8V.) because of its very low load. This, however, has not been found to be objectionable at all due to the relatively high value of bias resistance.

The rectifier diodes, D9 and D10 may be just about any type power diode. Those used in the author's keyer were the two for 49¢ variety, even though they carried a rating of 750 ma. at 600 PIV. Filtering of the keyer power supply is not at all critical so long as the hum amplitude is less than 20% that of the signal amplitude. Even with such a low impedance source, 100 to 500 µf is entirely adequate.

Easy-to-make keyer mechanism

Fig. 4 shows a side and front cross section of the keyer mechanism. The accompanying parts list and detail drawings in **Fig. 5a** through **5e** should be quite easy to follow. A number of different automatic keyer mechanisms are on the market today, but perhaps none is quite so easy for non-professional construction as the mechanism illustrated here. Accurate hole placement and squareness of corners are to be desired, but may be compensated for in final assembly, to some extent. It is important, however, that the paddle hinge pins fit quite snugly to provide a good electrical contact not only with the paddle but also with the top and bottom pieces, items 3 and 4.

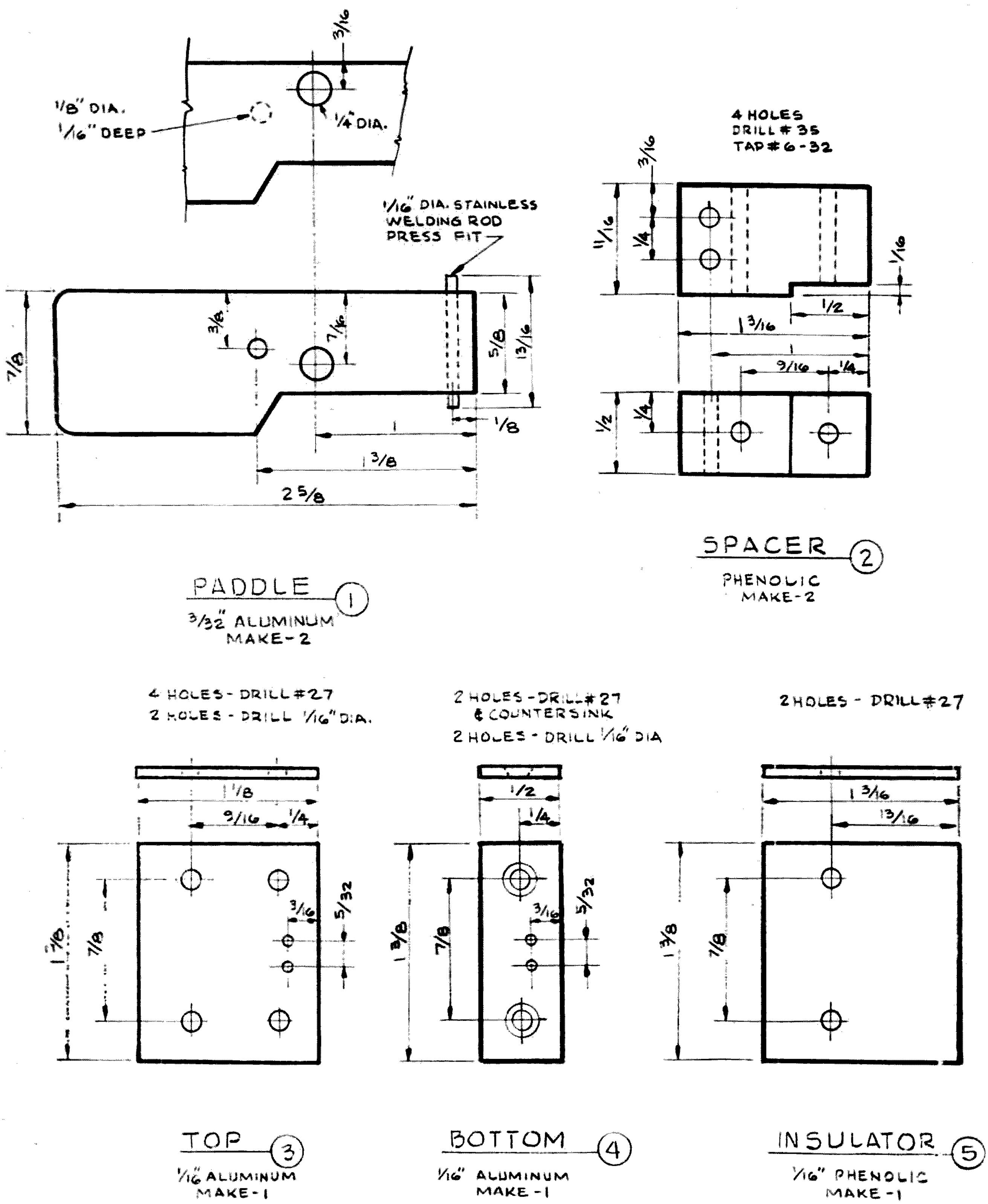
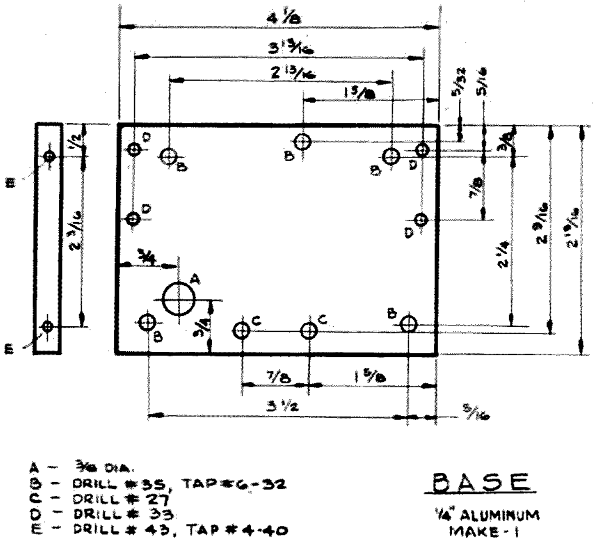
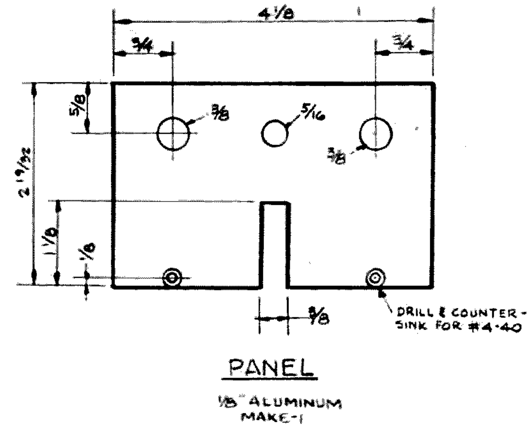


Fig. 5. Details of the keyer mechanism.

One unique feature of this keyer mechanism is the alternate placement of the back-stop adjusting screws, item 8, and the contact screws, item 9. The latter pass through a one-quarter inch clearance hole in one paddle in order to contact the other paddle. Once set, the four screws wil not need further adjustment to suit individual taste as is frequently practiced with a "bug."

The spring which serves to return each paddle after being depressed is a common spring, item 11, between the paddles. Care should be exercised in drilling the retention holes for this spring so that the hole is deep enough to retain the spring but does not pass completely through the paddle.





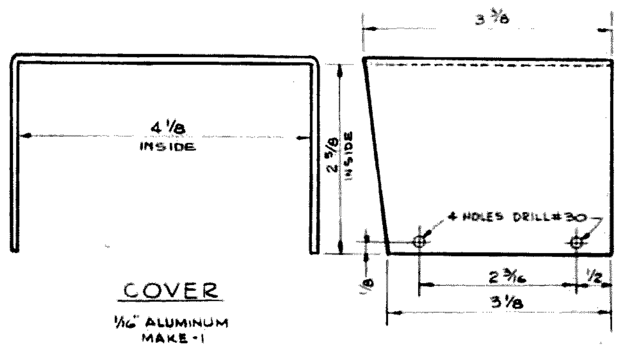


Fig. 6. Base; Fig. 7. Panel; Fig. 8. Cover.

Construction of the case

These parts are fabricated in accordance with **Figs. 6, 7** and **8.** A relatively soft aluminum is used for the cover allowing it to be readily bent between two pieces of wood in an ordinary vise. The base need not be ¼ inch thick although the weight and low center of gravity is helpful in preventing a "creeping-key." Indeed, the base may be made of brass or steel to further weight it down.

After all drilling, taping and deburring is completed, all aluminum parts should be thoroughly sanded with 000 sand paper to produce a uniform unidirectional scratch pattern. Some constructors may prefer to remove the scratches and impart a homogeneous satin finish to the aluminum. This can be done by bathing the parts in a glass bowl containing warm water and "Drano." Do not breathe the fumes and handle the parts only with rubber gloves or wooden sticks.

The front panel and cover are given two or three coats of flat black enamel from an aerosol can. A more durable finish can be achieved by baking the paint in the kitchen oven for about 20 minutes at 200 degrees.

Simple circuit boards

While it is desirable and quite gratifying to construct the circuit boards using printed circuit techniques, it is not at all essential. The method used by the author and illustrated in the photographs is quite satisfactory. The component leads are inserted through pre-drilled holes and bent over on the reverse side. In most instances, the leads are of sufficient length to reach their destination and be soldered in place. Twisting of the leads prior to soldering is not desired. Some rather long runs as well as the occasional cross-over leads should be insulated with spaghetti.

Figs. 9 and **10** show the power supply and digital boards respectively. One-sixteenth inch phenolic is used, either of the plain or perforated variety. The boards each measure 2¼ inches by 4 inches and are fitted with ½ inch angle aluminum feet cut from a strip of storm door stop. These feet should be tapped to re-

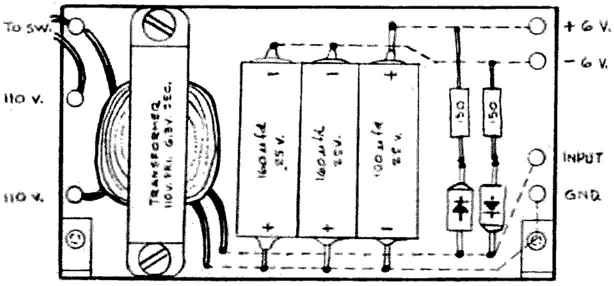


Fig. 9. Power supply board.

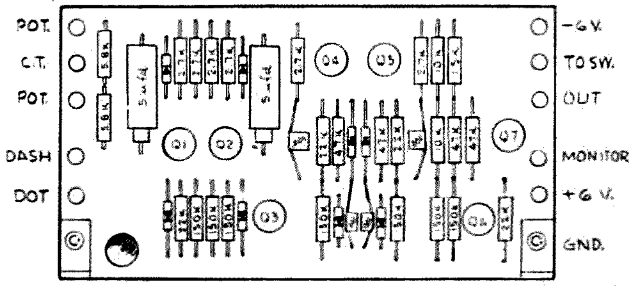


Fig. 10. Component board.

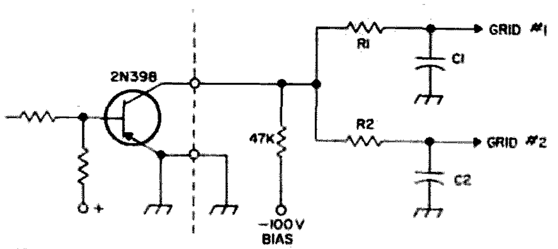


Fig. 11a. Application to grid-block keying.

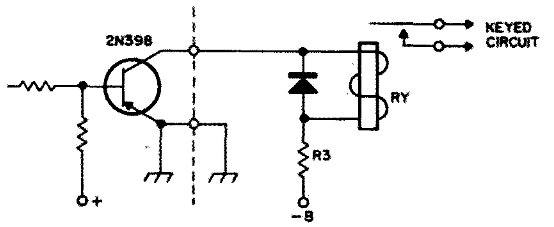


Fig. 11b. Application to relay keying.

Material for Keyer Mechanism

Item	Quantity	Description	Material
Item	Quantity	Description	Material
1	2	Paddle	3/32" aluminum
2	2	Spacer	Phenolic, cloth base
3	1	Top	1/16" aluminum
4	1	Bottom	1/16" aluminum
5	1	Insulator	1/16" phenolic, paper base
6	2	Screw	Flat head, #6-32, ¼" lng. steel, nickle plated
7	4	Screw	Round head, #6-32, ¼" lng. steel, nickle plated
8	2	Screw	No head, #6-32, ¾" lng. steel, nickle plated
9	2	Screw	Round head, #6-32, 1" lng. steel, nickle plated
10	2	Screw	Round head, #6-32, ¾" lng. steel, nickle plated
11	1	Spring	¼" long section from ball point pen

NOTE: Brass may be substituted for aluminum in the above parts.

ceive #4-40 screws from the base and may be either screwed or riveted to the phenolic boards.

Part placement is not at all critical because of the very low frequency and impedance encountered in the keyer. A little lacing cord will go a long way in dressing up the wiring harness and enhancing reliability.

Keying the transmitter

Der Keyer may be employed in a wide number of ways in keying the transmitter. Two of the more popular methods; grid block keying and relay keying are shown in **Fig. 11a & b.** The 47k resistor is provided to limit current thru the 2N398 to a safe valve as well as to prevent overloading the bias supply. R1 and C1 determine the time constant for grid #1 and similarly, R2 and C2 control grid #2 for differential keying. The B minus supply and R3 are selected to suit the keying relay. Actually, the built-in 6 volt supply in the keyer could be used. In this case, a 2N404 could replace the 2N398. In any event, a back connected diode across the relay is desirable to prevent the collapsing relay magnetic field from damaging the output switching transistor.

One improvement which should prove invaluable, is a built-in monitor. This has been done since the pictures were made. A 3-transistor imported amplifier, phase-shift network and 2-inch speaker are all that are needed.

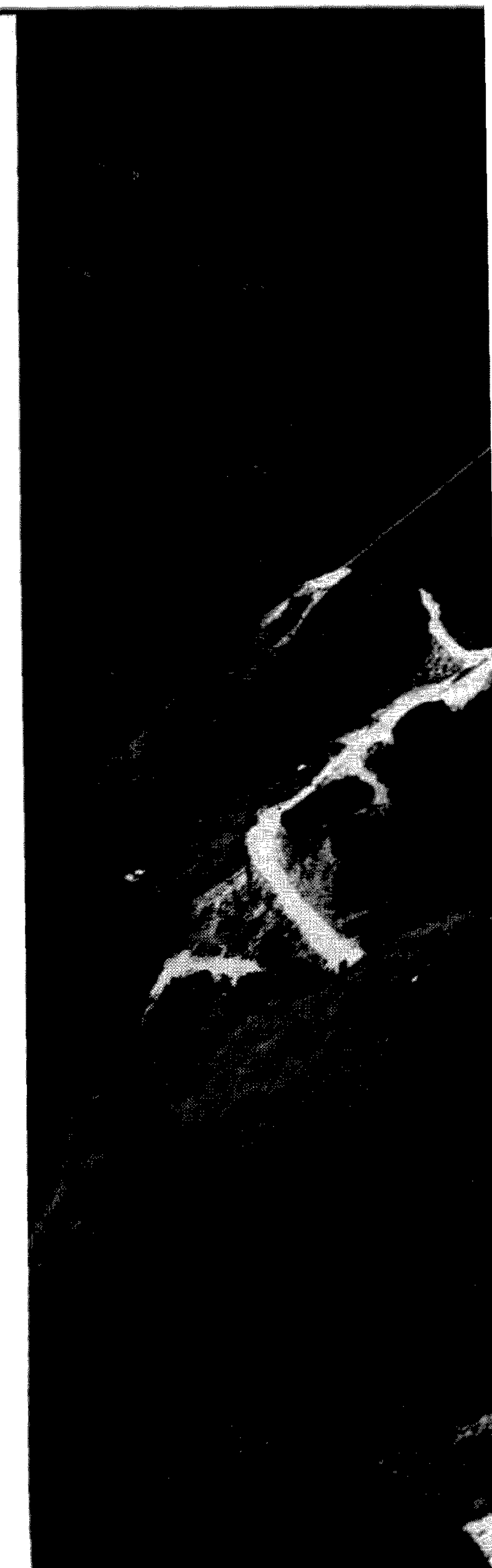
The proof of the paddling

Once an operator becomes accustomed to an automatic electronic keyer, he will be satisfied with none other. Fatigue is reduced and accuracy increased. Speed of sending is significantly increased; sometimes to the point where we can't receive so fast. In all, Der Kleiner Keyer is a very worthwhile project and a real honey to use.

Thanks to Dave Lyndon, WA2JGJ for his asssitance on the circuit and in checking out the finished keyer

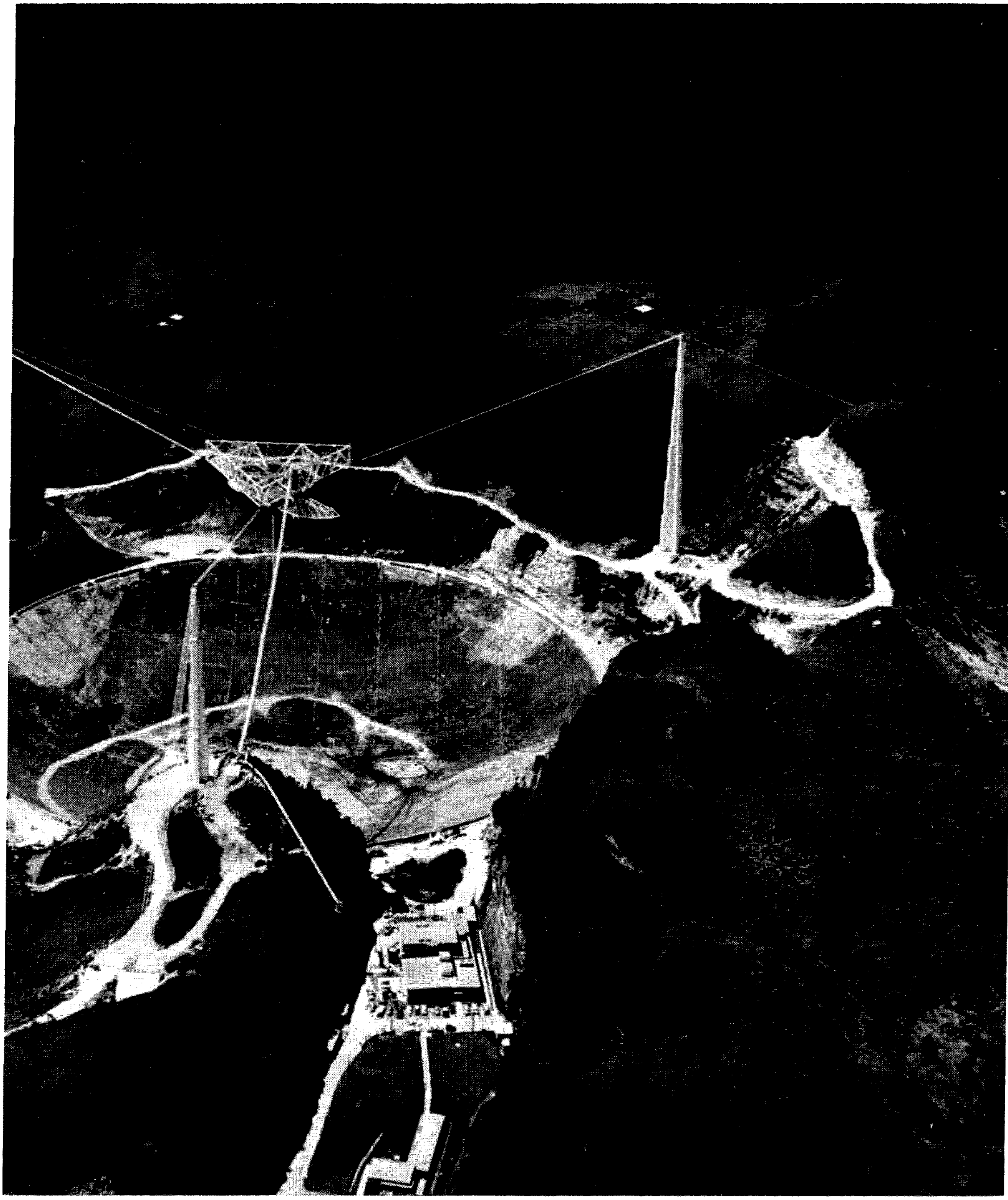
. . . W4UHN/WB2KPE

QRM on 432



It was like 20 meters on a busy afternoon. The moon lumbered into place, right on schedule, and Gordon casually picked up the mike, watched the clock, and at 1111 GMT he pushed the button and called a short CQ on 432.00 SSB. When he finished we turned on the receiver and were met with bedlam . . . CW, SSB, AM, all mixed together up and down the band. We tuned in amazement, listening to the dozens of signals, largely crowded around the low end of the band.

The loudest of all was WA6LET calling us on sideband. Three hours later we had made 39 contacts via the moon, eight on sideband, and including all call areas, Canada, Germany, England, Sweden, Netherlands and Denmark.

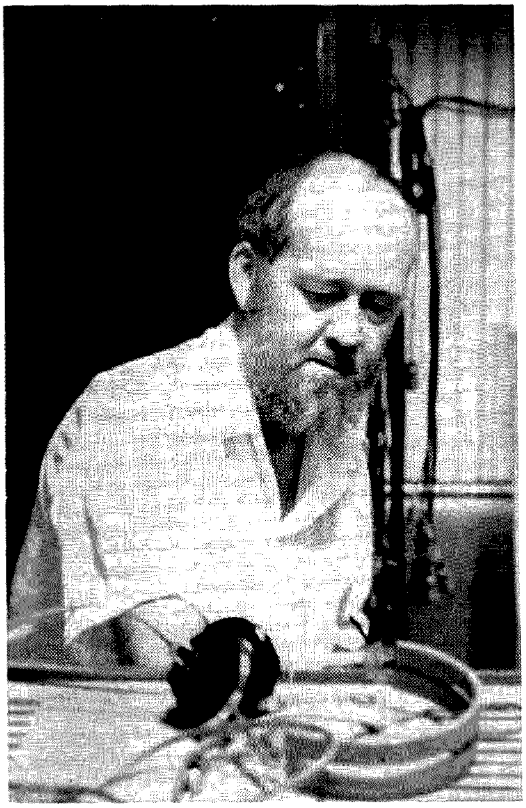


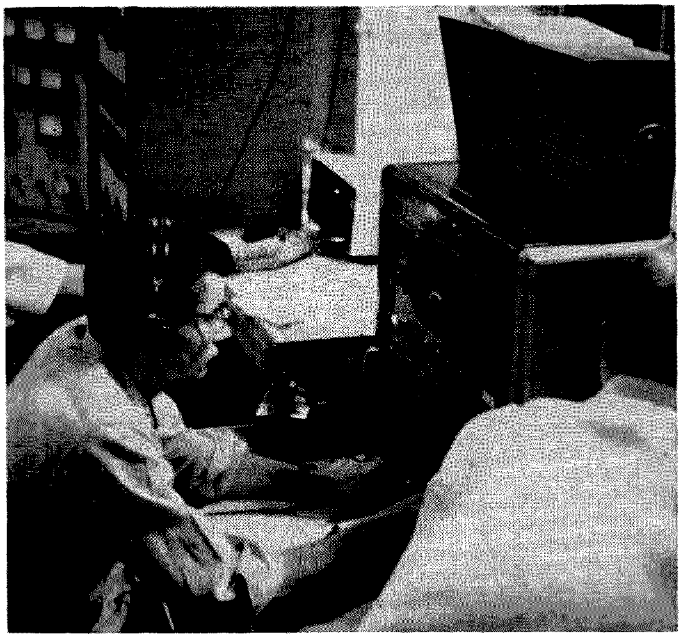
)f course there were dozens of frustrated peo-
ıle all around the world who had tried to
ıake the hop and failed. In order to minimize
he frustration from this aspect we taped the
25 kc band complete on an eight channel
ecorder along with the audio outputs from
wo receivers, the sounds in the transmitting
oom, WWV, and a flutter removing synchronizing channel. This means that Sam (W1FZJ/KP4) will be able to play back the tape several times and retune the band, copying signals that were missed the first time through. Eventually he should be able to copy every signal that actually made it down to Arecibo via the moon.

I've been fascinated by the moonbounce

Left. The historice moment: Gordor KP4BPZ calls CQ 432 moonbounce

Below. Sam W1FZJ/KP4 tunes the R390 receiver, trying to sort out signals through the QRM.





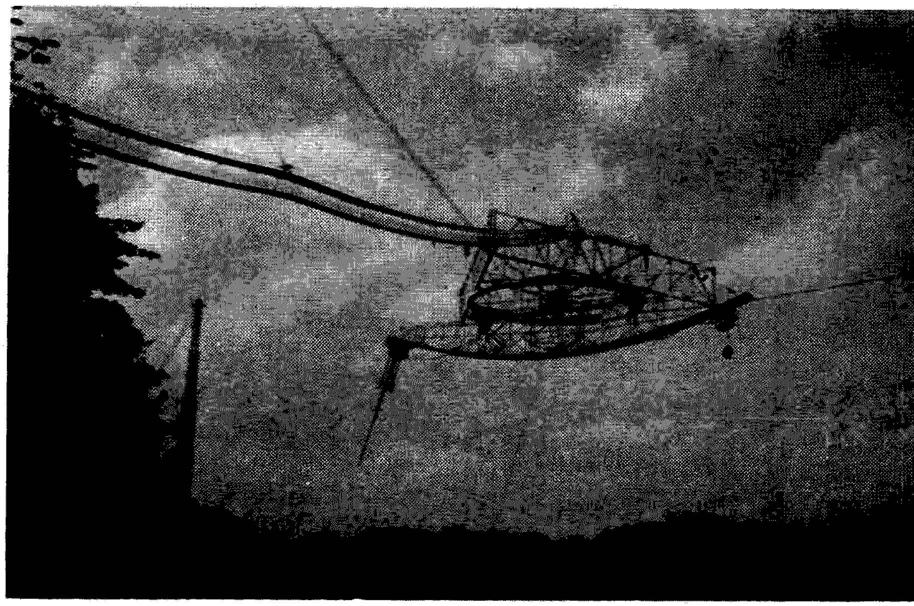
Left. Walt K2KWL/KP4 tunes the other receiver. We worked the best signals they could find.

contacts that have been made from this 1000 foot dish and all it took to get me to come down was the slightest hint of an invitation from Sam. They had two skeds, one on July 3rd, the other July 24th. My hamfest was the 4th, so I had to wait until the 24th to come down. I zipped down on the 23rd, rented a little VW in San Juan and drove the 50 miles along the nort coast of the island to Arecibo.

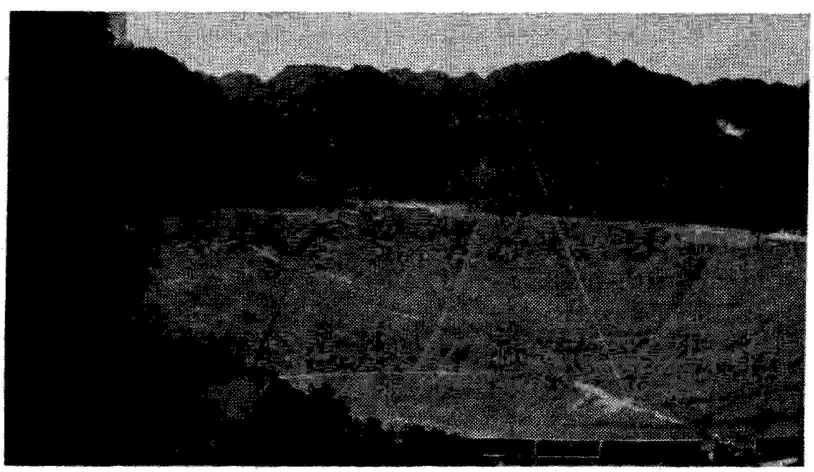
Sam and Gordon Pettengill KP4BPZ worked pretty late that night getting everything ready for the morning test. Then we got together and talked even further into the night, finally getting to bed around 1 AM. At 4:30 the alarm clocks started banging away, adding their dim to the insistent crowing of the damned roosters which seem to be everywhere down here.

After a quick breakfast we careened out the winding narrow road through the mountains for twelve hairy miles. The road is one car wide and the usual driving pattern here is to drive as fast as possible, blowing the horn steadily because the roads are made up of blind turns . . . I think Sam said there are 176 dangerous turns on the road to the dish. Perhaps this is why it is hard to find undamaged cars here. The fellows that work out there drive that road every day . . . I guess you can get used to almost anything.

We arrived at the lab in the grey light of pre-dawn. What a spectacle! A 1000 foot dish covers 18 acres and is over three football fields long. Immense . . . huge. The dish is hung in the air about twenty feet above the ground and is kept at an accuracy of much better



Right. The antenna hangs down from the feed structure, moving on the track to follow the moon. It is automatically run by a computor.



The 1000 foot disc is concave, a part of a sphere, not a parabola. The idea is to swing the antenna feed to follow the moon rather than having the disc itself pointed, as it would be with a parabola.

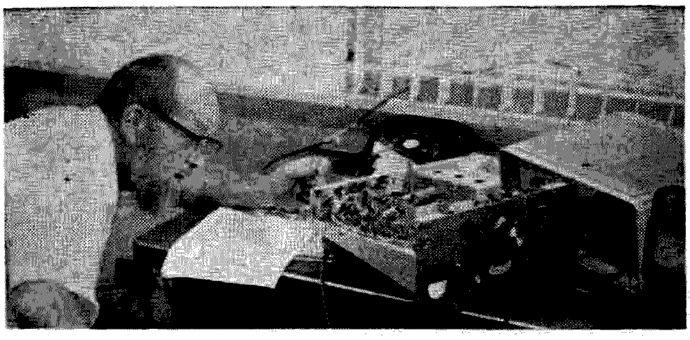
than an inch, in spite of winds, rain, and the beating down sun. Slung above the dish from three tall towers is the antenna cab system . . . which also must be held to less than an inch . . . no swaying in the wind here. This all calls for special cables, special paint, and incessant care.

In addition to Gordon KP4BPZ (W1OUN) I found KP4BEU Andres Sanchez who was going to run the audio tape recorder for the test, Bill Black KP4COO (ex K4BSN) who would mind the antenna (the antenna was actually run by a computer which had been fed the predicted locations for the moon for the duration of the test), Dr. Rolf Dyce K6DSJ-KP4CMO who would run the i-f plus audio tape recorder, and Walt Zandi K2KWL who would tune one receiver, Gordon would do the operating of the transmitter and Sam would tune the second receiver. I found that I was the head log keeper.

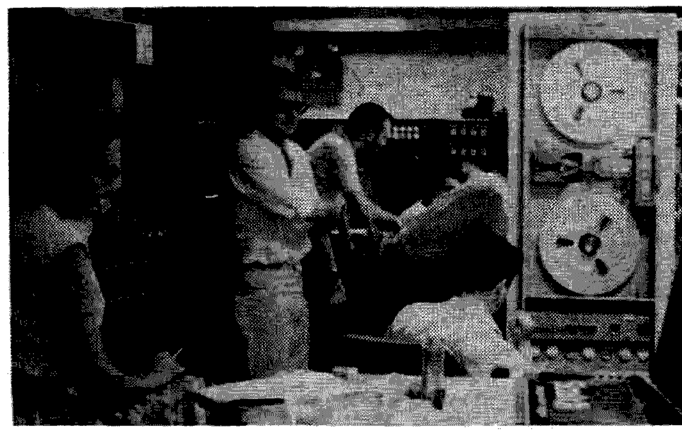
The dish was a gain of about 58 db. Compare this to the 6 db that you would normally expect to get from a three element beam, manufacturers claims notwithstanding. It is about comparable to a 25,000 element beam antenna. The parametric amplifier gave a noise figure on receiving of about ½ db. With a dish this size the beam is so narrow (which is what all that gain means) that it is one sixth the width of the moon, and the moon is about ½ of a degree wide.

There was a last minute flurry when we discovered that we had forgotten to bring the power cord for a third receiver that we hoped to use. Those of you who have tried to figure out a 75S1 without the schematic know how futile our efforts were.

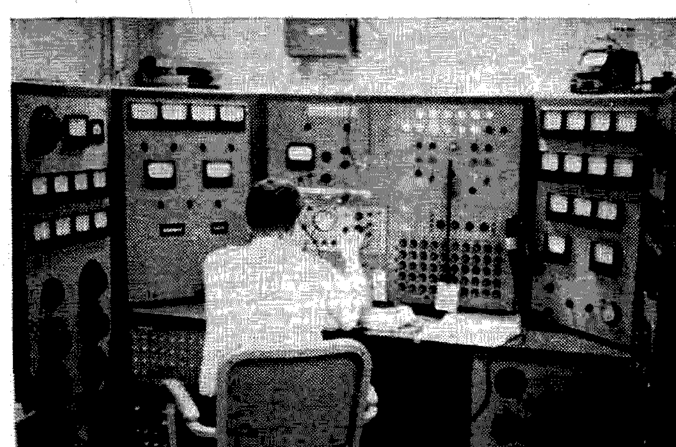
The transmitter, which usually puts out 2½ megawatts of pulses for interplanetary radar tests and runs about 150,000 watts dc, was tamed down to our legal maximum. Scoffers should know that in order to run the rig at any higher power they have to use a slow motor



Left. Sam tries to figure out line cord connections for the third receiver.



Left. Helen W1HOY/KP4 on the left, Swiss computer engineer with glasses waiting for us hams to get out of the way so he can get back to work. Tape recorder is taping entire passband of the receiver for later tuning of the band. Dr. Dyce K6DSJ/KP4CMO checks recorder.

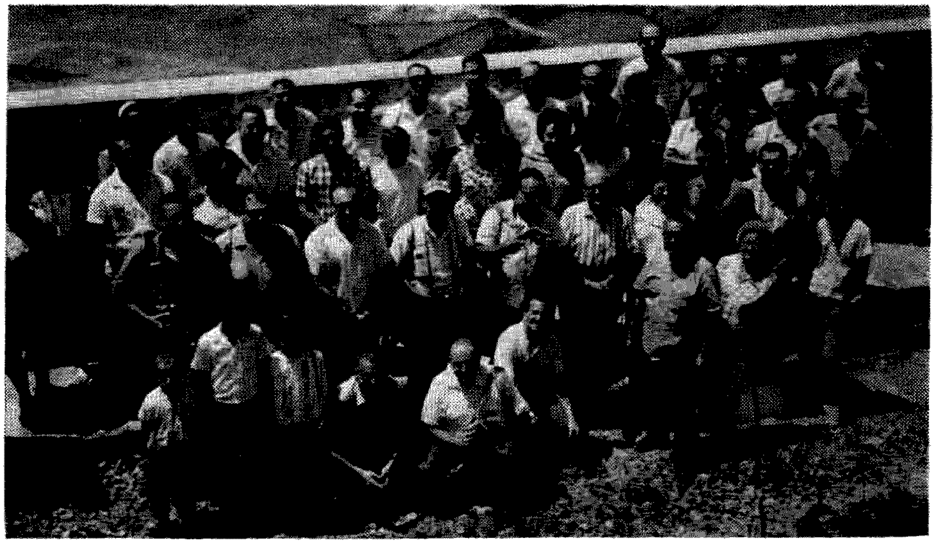


Right. The big rig is tuned remotely from the control room. 150 kilowatt final was idled with kilowatt driver working straight through it for the ham test.

driven Variac which takes about two minutes to operate. We had little enough time for the tests without sitting around for two minutes every time we turned on the transmitter.

The moon was scheduled to be within range at 0711 local time and at the appointed hour, with the sun beginning to shine down into the dish, all systems were go and Gordon made his last transmitter test and announced that KP4BPZ was standing by on 432.

We'll know better how many stations were on when Sam gets through reading the tape, but our guess is that about a hundred stations made it over the path. This is quite something when you think about it. This is not easy to do at all. In order to get a signal that we could copy, even without big antenna, you had to run a fair amount of power and a sizable antenna. The fellows that made it were running a minimum of 100 watts, with most of them up around a kilowatt. The antennas were mostly dishes of various sizes, ranging from the 150 footer at WA6LET to the 60 footer at K2MWA, the 30 footer at W1BU (W1HIV), down to an 8 footer used by one of the Europeans. We worked quite a few fellows using collinear antennas, the smallest being about 64 elements and the largest we know about being 96 elements used by VE2LI. For the most part yagi antennas just didn't make it. WA4BYR did get through on SSB with a 32 element yagi and 500 watts.



Some of the KP4 hams and their families who turned up for the hamfest the day after the 432 test.

SM7OSC had four 15 element yagis.

I talked with Sam quite a bit to try to find out what you have to know to get a signal through to him. Assuming that you've picked a reasonable antenna, built a good converter, and have some power available, how can you tell if your stuff is working. Simple, says Sam, just point your antenna at the sun, the best noise generator (and least expensive) we've found yet. If you don't hear the sun then you aren't in. Now if you want not only to work Arecibo, but hope to work some of the other fellows, you've got to have a system that will hear its own signals coming back from the moon. This takes a kilowatt plus at least an 18′ dish or equivalent.

So far probably only four or five fellows have systems that are capable of receiving echos back from the moon. I know of W1BU, K2MWA, WA6LET and KP4BPZ.

One interesting problem when tuning for moonbounce contacts is the 2½ second time delay for the signals to reach the moon plus 2½ more for the signals to come back. You sure don't work any fast break-in over this path. And when you tune in someone just standing by there is no use breaking back and asking for a repeat on his call.

We wasted a lot of time listening to fellows calling our call over and over. This seemed like a strange way to waste everyone's time. We knew that everyone was calling us and what we wanted to know was their call, not ours. I suspect that the procedure for the next test will be a bit different, with the Arecibo end standing by for each station known to be calling in order for an exchange of signal reports. It would seem prudent to have your station call and frequency on file with Sam (Box 1738, Arecibo) so you'll get called. Once they've worked everyone on the list they will look around for unlisted stations. This will help to keep two stations from trying to use the same frequency too.

There is no way to know when any further tests will be made. Gordon will soon be going on to another big dish project and we may be hearing ham signals from a new source. We don't know how receptive the new director of the Arecibo Observatory will be to our amateur radio, but we can all hope.

Though Sam has only been down here about a month he has already been looking around for a good ham location and seems to have found a corker. He's thinking seriously of making a smaller version of the $8,000,000 dish, something about 330 feet in diameter. He wants to poke good moonbounce signals on 144 and 432 mc. I'll bet he does it too.

KP4 Hamfest

I mentioned to KP4AXM (Sandy) that I was planning on visiting Arecibo and he suggested that I arrange some sort of hamfest. I checked with Sam and got the go ahead. KP4JM, the SCM, got a letter out to just about everyone telling them that I would be here and that all were invited to come visit the observatory. About fifty hams plus their families turned up on Sunday morning and we all had a wonderful time going through the lab, getting a close look at the dish, and riding up the cable car to the antenna carriage. Quite a few of the fellows drove all the way across the island from Ponce, a rugged slow trip. I was particularly glad to see Bill Thomas KP4CF (ex KV4BB), whom I had visited on my last trip to the Virgin Islands back in 1957.

. . . W2NSD/KP4

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Sioux Falls, S. D.

Practical Meteor Scatter

Meteor scatter propagation, if it can rightfully be called "propagation", was discovered some years ago but has received attention only from the military and a relative small number of two meter men looking for ways to work DX on 144 megacycles. While the number of two meter men using meteor scatter has increased in the past four years, it has been nearly 2½ years since I have seen anything in an amateur publication on the subject. It has been eight years since W4LTU's article which has become the bible of meteor scatter enthuiasts was published in QST.

While I do not claim to be any kind of an expert in the field, I think it is time to review meteor scatter techniques and possibly interest some other operators in the field.

Meteor scatter, or MS, is not a method of communication for the ham equipped with a five watt transceiver, but is an interesting challenge for the operator equipped with at least 100 watts of CW into a honest 10 db antenna, a stable and selective receiver and a reasonbly good converter.

Before discussing station requirements let us first explore just exactly what MS is.

Basically MS is an attempt to reflect signals off ionized trails left by meteorites as they enter and burn up in the earth's atmosphere.

The earth is bombarded daily by a fantastic number of these minute particles. If it were not for our atmosphere which burns them up, the earth's surface would resemble that of the moon.

During certain periods of the year the earth passes through concentrated streams of meteorites. These streams, or showers, are dense enough at times to cause sufficient ionization allowing reflection of two meter signals.

Thirteen major showers occur each year, and in peak years, can provide amazing signals in terms of strength and duration.

Table I is a table of showers that are of most interest to two meter hams.

This table is an "educated guess" as to the dates, best times and directions but will be found to be fairly accurate.

The number of meteorites in a given shower can, and does, vary considerably from year to year in intensity. However it is wise to arrange schedules for each of them.

In past years the Quadrantids in January have produced some QSO's but the shower

SHOWER AND DATES	OPTIMUM PATHS AND TIMES N-S	NW-SE	E-W	SW-NE	PERIOD	NEXT MAXIMUM
January 1-4 QUADRANTIDS		0300-0800	0800-0900	0900-1400	7	1967
April 19-23 LYRIDS	0230-0530	2330-0100		0700-0830	400	2261
May 1-6 AQUARIDS		0830-1000	0630-0830	0300-0630	76	1986
May 19-21 CETIDS		1100-1230	0900-1100	0730-0900	37	-*
June 4-6 PERSEIDS	0800-1000; 1300-1500				29	-
June 8 (2-14)	0600-0800; 1100-1200				38	-
June 30-July 2 TAURIDS	0700-0900; 1300-1500	1130-1300	1030-1130	0900-1030	31	-
July 26-31 AQUARIDS		0300-0500	0100-0300	0000-0100	3.6	-
August 10-14 PERSEIDS		2330-0300	0300-0800	0800-1130	108	-
October 9 GIACOBINIDS		1100-1600	1600-1700	1700-2200	6.6	1965
October 18-23 ORIONIDS	0000-0200; 0600-0800	0430-0600	0330-0430	0200-0330	76	1986
November 14-18 LEONIDS	0300-0500; 0800-1000				33.2	1965
December 10-14 GEMINIDS	0030-0330	2130-2300		0500-0630	1.6	-

* Blank means showers are about the same each year.

Table I. Most important meteor showers.

this year was extremely good and signals rivaled the best shower of them all, the Perseids in August.

Using the table is not complicated and a close examination will show it to be fairly self-explanatory.

Suppose W4VHH wants to schedule KØCER during the Quadrantids between January 1st and 4th. The path between the two stations is northwest to southeast and the table shows the optimum time is between 0300 and 0800 local standard time. The shower peak is centered on 0530 LST so the two stations should schedule at about this time taking into consideration the time zone changes. An hour or so either way probably won't make too much difference.

Equipment

Earlier, mention was made of equipment requirements. Now for a closer look.

Power? The higher the better! Here is where you MS professionals may begin to disagree with me.

Success can be achieved with 100 watts of CW *in the antenna.* However, most of the fellows are running from 500 to 1,000 watts input with such bottles as 4X150's and 250's. I have worked MS with 125 watts input and a 10 db antenna but it was spotty and every extra db helps. MS is a CW game, and SSB has been used but the wide bandwidths and power losses associated with AM and FM phone make results from those modes highly unlikely.

After you have those precious watts of RF don't throw them away in the feedline. All serious 2 meter DX'ers use either open wire feeders or a *good* quality of coax.

This leaves out RG-58/U and the like and you had better think twice about using RG-8/U. This rule applies to any VHF work. RG-17/U is commonly used because of its low loss and ease of installation. Open wire feeders are the best in terms of low loss but they present more installation problems. The money you spend for feedline is the best you will ever spend on a VHF station. It does no good to pump a fine signal into a feedline that is no better than a wet piece of string!

Antennas are a complete subject in themselves and there are many types in use. Probably the most common is a pair of stacked yagi's followed by quad configurations, colinears, skeleton slots and single long yagi's. The largest antenna you can put up will be the best if it is properly installed and adjusted.

Capture area of the array is important because we are dealing with relative small amounts of received signals. Remember, the

HEIGHT Wave Lengths	- Feet at 144 Mc.	DISTANCE Miles
1	6.8	430
2	13.7	720
3	20.5	900
4	27.3	1020
5	34.0	1090
6	41.0	1130
8	55.0	1230
10	68.0	1280
12	82.0	1310

ANTENNA HEIGHT CHART

Table II. Optimum antenna heights.

gain of the antenna system applies to both transmitting and receiving.

Before selecting an array, check on what the successful MS operators are using, and don't be mislead by some of the fantastic gains some antenna manufacturers claim for their products. You will find the serious two meter man willing to give you advice and steer you in the right direction.

Charts have been worked out for the best height to mount antennas for MS work. Table III is excellent, but if you can not achieve the optimum height at least make sure the array is not buried among trees or power lines.

Receivers and converters are equally important in a successful MS station. The most important factors are a low noise figure, stability, selectivity and good calibration.

The majority of MS operators use receivers in the Collins bracket although some of the other better receivers are in use.

You will need a receiver that is calibrated at least every 5 kilocycles and 1 kilocycle calibration is to be desired. An MS signal is here and gone in seconds and you have to be on the other station's frequency. There isn't signal or time enough to be hunting all over the dial. Most MS operators know their frequency within 500 cycles.

This is why stability is important. Many premature grey hairs have appeared when a receiver drifted at the wrong time!

A 2.5 kilocycle bandpass is probably the best overall choice, giving a better signal to noise ratio than a wider bandpass but still being broad enough to find a signal and hold it in the bandpass. Even crystal controlled signals will shift slightly when the crystal heats up. VFO's, except a few highly stable multiplier chains, are out for MS work. Stability can't be stressed too highly!

There are several fine commercial converters available or one such as the W2AZL can be built.

Everyone talks about noise figure and how to measure it. One quick way to make sure your converter is operating well is to disconnect the antenna input. If the background noise in the receiver drops noticeably the converter is usually working well. If the noise remains the same, or rises, you had better do

Nothing or incomplete calls	Calls only	S1	Up to 5 sec
Complete calls	Calls and signal rept.	S2	6 to 10 sec
Calls and signal rept.	Signal rept. and ROGER	S3	11 to 15 sec
Signal rept. and ROGER	R's continuously	S4	16 to 20 sec
2 or more R's	Nothing	S5	over 20 sec

QSO EXCHANGE CHART

some work because you may not be hearing the weak ones.

When selecting an *if* input frequency for the converter, consult the Handbook or similar publications. The rule of thumb here is to select the highest frequency at which your receiver functions well in the manner previously discussed.

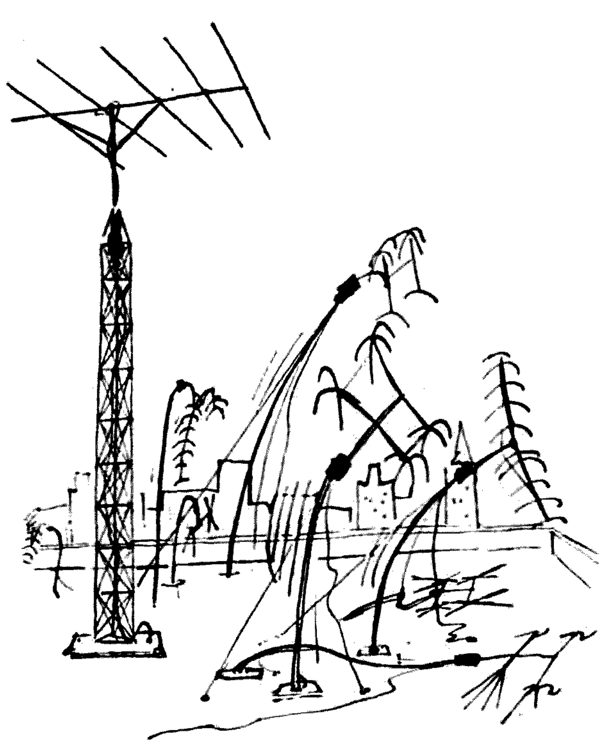
That is a brief run-down on basic station requirements. As you progress in the MS field you will find such items as tape recorders and automatic keyers helpful but not absolutely necessary.

Now that the equipment is ready, how do we make the actual meteor scatter QSO?

First, you arrange a precise schedule with a station depending on the information in Table I.

There has been much discussion on what actually constitutes a QSO. MS operators have arrived at a system that leaves no question whether or not a valid QSO has been made.

This is the system that is used by most operators. As the schedule begins, both stations are sending calls only, i.e., W4VHH de KØCER W4VHH de KØCER, etc. This continues until both stations receive a *complete* set of calls. Then calls and signal reports are sent, i.e., W4VHH de KØCER S2 S2 W4VHH de KØCER S2 S2, etc. (The signal report is based on Table III.) This procedure continues until both stations receive their signal reports, then reports and a roger are sent, i.e., S2R S2R S2R, etc. When this is exchanged, only rogers are sent, i.e., RRRRRRRRR. When two or more R's are received you stop sending... you have made it! A look at the chart will help clarify the procedure.



These transmissions are made with precise timing by following a clock with a sweep second hand exactly calibrated with WWV. Usually the station on the western end of the circuit sends first. Schedules are usually arranged so each station makes either one 30 second transmission each minute, or two 15 second transmissions each minute with the western station taking the first 30 seconds or the first and third 15 seconds. I don't know why it is customary for the western station to transmit first, it probably all just started that way. Most schedules run for one hour each day during the shower.

It is useless to send an S-1 report because by definition an S-1 signal lasts only a maximum of five seconds and even at keying speeds of 25 to 30 words per minute it takes about that long to send a set of calls. The minimum report usually is an S-2 which indicates a received transmission of up to 10 seconds, or long enough for calls and signal report. We just mentioned keying speeds of 25 to 30 words per minute. This is the speed used by most MS operators and even though you may not be able to copy 25 wpm solid on paper, I bet you will recognize calls, signal reports and the letter "R".

This article was intended only as a brief look at MS operation with the hope that it will encourage others to try this fascinating method of DX on 144 megacycles.

Part of the information for this article was taken from articles written by W4LTU in QST for April of 1957 on page 20 entitled "VHF Meteor Scatter Propagation," and W3TDF's article "Meteor Scatter" in the October 1962 issue on VHF Horizons, page 30. Both articles are excellent and I highly recommend that they both be read.

Yes, a meteor scatter QSO takes time, patience and some work, but the rewards are there for those who wish to try and "advance the state of the art."

. . . KØCER

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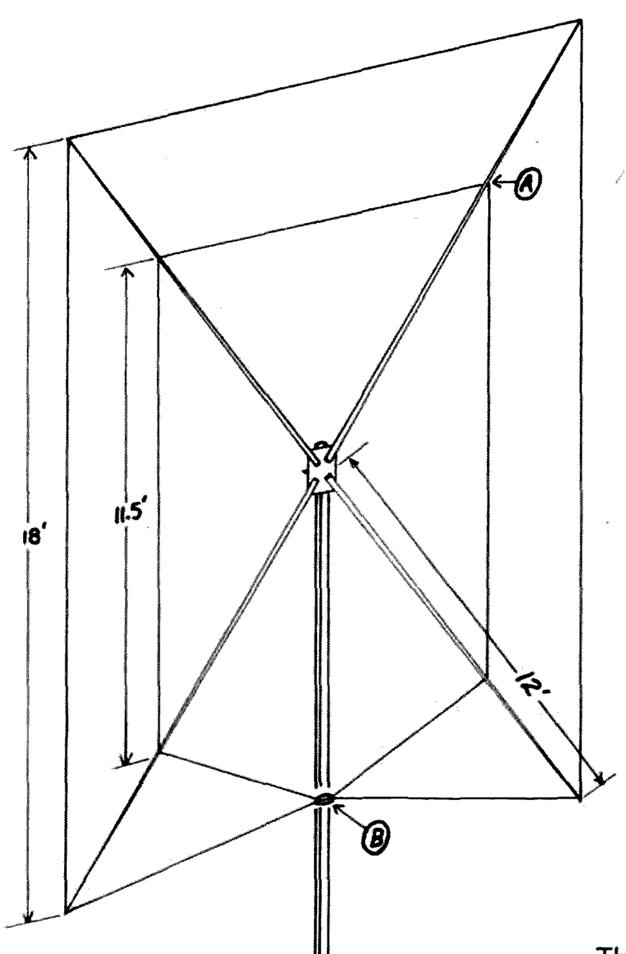
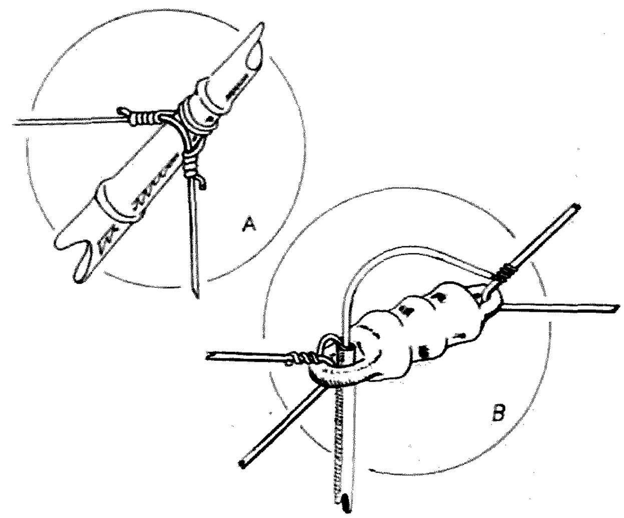
A Simple DX Antenna

A simple quad element forms a simple and effective DX antenna for the amateur faced with a limited space problem. This antenna will provide considerably better results than a simple dipole, due to the lower vertical angle of radiation achieved at heights below a half-wavelength. Similarly, the quad will afford less noise pickup in the receiver than a vertical or ground plane. Addition of a reflector element at a future date can easily be accomplished if the additional gain is desired.

A recent change in location at W6WAW resulted in a drop to zero in European contacts. Although the actual move was less than a mile, several discouraging factors soon became apparent. Primary among these was the fact that the base of the Hollywood Hills was now only two blocks away, directly in the polar path, while a very tall palm tree in close proximity to the only available spot to mount the all-band ground plane was absorbing all the rf in that direction. The ground plane produced excellent reports in all directions except towards Europe however, so it was decided to put up a fixed beam aimed roughly 30 degrees East of North. The "old standby" 8JK or a fixed parasitic array were considered, but again the palm tree would be in the way.





The simple quad with typical details.

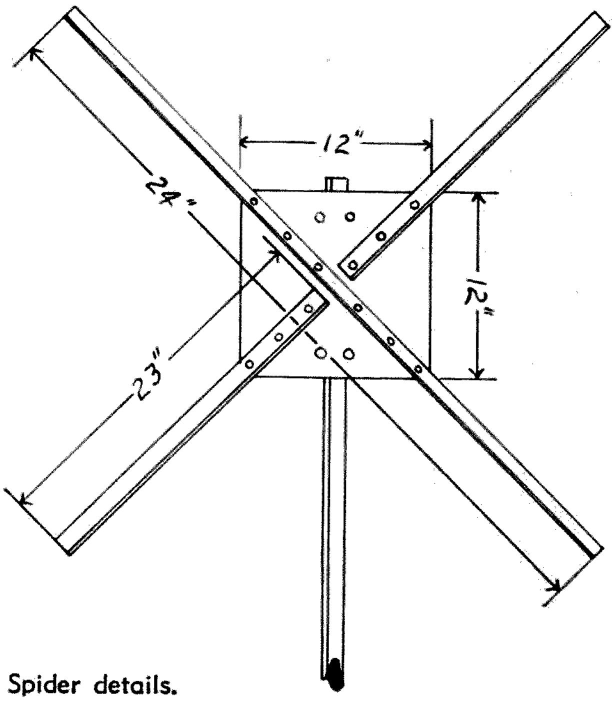
After researching the possibilities of various antenna configurations, a quad was selected as the best solution, and a two element 14 mc array drawn up. However, as the first weekend of the DX contest was only 24 hours away at this point, it was decided to put up a single quad element for use during the contest and hope for the best. The results obtained with this antenna were much better than had been anticipated, including reports from Europe that equalled those from the old QTH. The decided decrease in receiver noise was also a boon, especially as Fairfax Avenue is one of the major North-South streets in the Hollywood area.

The antenna was built and put up in less than two hours, with the further advantage that no outside help was required. The basic "spider" assembly was fabricated from a 12 x 12 inch piece of ¼ inch thick aluminum, and 8 feet of 1 inch "do-it-yourself" aluminum angle stock. A suitable piece of plywood would probably have served just as well, but the aluminum was available, so it was used. The bamboo arms are a few inches over 12 feet long, wired securely to the aluminum angle to provide maximum support.

The wire element was made up by soldering a glass strain insulator to one end of a 100 foot roll of #14 stranded antenna wire, tying it to the garage door, and then applying "VW pressure" to pre-stretch the wire. The wire was then measured off and cut to length at 72 feet. A piece of tape was placed 9 feet from the insulator, and three more at the subsequent 18 foot points to facilitate assembly by marking the points of contact between the wire and bamboo.

The spider assembly was attached to a 15 foot mast, made of 1¼ inch TV mast sections by means of two U-clamps. A vent pipe clamp was attached to the other end of the mast and three guys of nylon clothes line were pre-cut and lashed to the lower U-clamp. The wire element was stretched around the bamboo frame and secured to the end of each pole by small lengths of #14 wire, twisted tightly around the pole and well soldered. The free end of the element was then attached to the insulator and soldered after the slack was taken up. Two of the guys were secured and the antenna raised into position, slipping the vent-pipe clamp over the sink vent on the roof. The array was roughly oriented on Central Euorpe/Australia, and the third guy line tied off.

The antenna reference books indicated that the feed point impedance of a single quad element would be around 125 ohms. The only available transmission line of sufficient length was a piece of RG-59/U, which would produce



Spider details.

a theoretical SWR of 1.75:1, but as this was under the nominal 2:1 limit it was connected across the insulator, soldered in place, and the transmitter fired up as the contest was now 16 hours old.

The first contact on the quad was with FO8AA, with the report approximately the same as that normally obtained on the ground plane. Several UAØ and JA stations were worked off the end with QSA 8/9 reports, while an HK off the other end produced an S6. This seemed to indicate a "skewed" pattern, probably caused by direct connection of the unbalanced transmission line as the shield was connected to the side "pointed" at South America. Further checks performed with a Stoddart NM-22A Field Intensity meter showed this to be true, but, as many European stations were worked without difficulty, it was decided to leave well enough alone; the antenna was serving its purpose admirably, while the one case of TVI at the new location was reduced considerably. A check on the SWR at the feed point of the antenna and also at the output of the Matchbox showed approximately 1.8:1 from 14000 to 14050 kc, and 1.95:1 at 14100 kc, which was considered low enough to be tolerated.

A 21 mc section was later added to the array and paralleled across the insulator. This element was made up in the same manner as the 14 mc element, however, the total length was 46 feet, being 11.5 feet on each side. The SWR on 21 mc was lower, ranging from 1.31:1 at 21000 to 1.71:1 at 21200 kc, while the overall effects on 14 mc operation were nil for all apparent purposes. As a bonus: 7 mc operation can be had in addition, by connecting a 28 foot 9 inch length of 300 ohm twin lead across point "X" and shorting the far end. Operation on 14 and 21 mc will not be affected.

By employing the vent pipe as a pivot point the antenna can be rotated through approximately 135 degrees of arc if the guys are properly spaced. This, together with the fairly broad lobe and bi-directional radiation pattern has provided good world-wide coverage and resulted in all six continents plus Antarctica being consistently worked on 14 mc in the midst of the sunspot slump, without resorting to opening negotiations for a kw final.

The purist may cringe at some of the engineering practices employed in this antenna, and the array at W6WAW is certainly not the optimum to be expected from the configuration. However, the antenna does provide exceptional results on G, LA, DL, UA1, VP8 etc., while the same purists are explaining their 1.01:1 match to a guy within ground wave range and bemoaning the fact that no DX is coming through!

The total height to the center of the array is 26 feet in this case; however, even at this height the low angle of radiation of the quad is apparent from the results. Mechanically the array seems quite secure, having survived one of the local 'Santa Anas' a week after it was put up.

The mismatch in feeding the antenna has not been corrected to date; however, the "skewed" pattern could easily be corrected by use of a gamma match. It was decided to let this change wait until the reflector element is added and a TV rotator installed.

In conclusion: the single element quad has the following characteristics. If any of them meet your requirements, start building; you will be pleasantly surprised at the results obtained.

1. Requires half the space of a Yagi, 8JK, or dipole
2. Requires only a single support
3. Provides lower angle radiation than other horizontal arrays at heights below a half wavelength
4. Requires no radials
5. Costs about $5.00 for a 14 and 21 mc version (excluding coax)
6. Produces less noise in the receiver than a vertical or ground plane
7. Can easily be converted to a two element configuration with approximately 6 db forward gain.

. . . W6WAW

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The Ultimate Transmitter Control

If your rig suffers from chronic "Haywire Strangulation," or you have to dance a jig to change over from operating one rig to another, read on and see what fortitude and wire cutters can do to cure those common ailments. Of course a little time, effort and some parts

Fig. 1—Control panel

(many of which are probably just waiting in the junkbox) are involved, but the long range dividends of a carefully thought out control and distribution system are too numerous to ignore. Not the least of these is safety, both for yourself and for your rig(s), and certainly there is much to be said for operating convenience and enough flexibility to cover even future rigs.

However, before starting any drastic surgery, let's explore some control circuit ideas and see just how they can be applied. The panel shown in Fig. 1 is a compact solution to centralizing the control functions for several rigs. The controls (l-r) consist of a master line switch (push buttons), control interlock disabling switch, plate supply high-low switch, rig selector (rotary) switch to take care of all power supply, filament and rf switching required to operate the selected rig, and a tune/manual transmit switch.

The indicators (l-r) are red, for a power supply failure or overload, amber in a delay circuit which prevents applying plate voltage prematurely to certain unsympathetic tubes and green to indicate that the filaments are on.

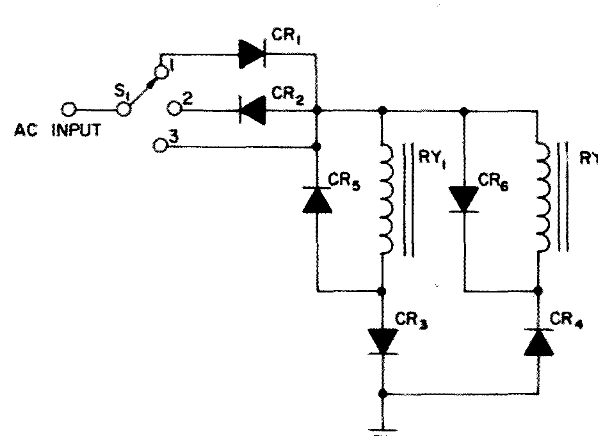

Fig. 2—RY_1 & RY_2, 250 ohm coils, rated 12-24 vdc
$CR_{1, 2, 3, 4}$, 750 mil 100 piv
CR_5 & CR_6 1N34 type
control voltage; 24 vac (rms)

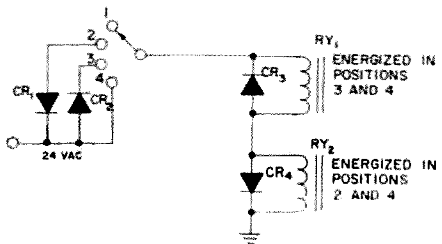

Fig. 3—CR_1 & $_2$, 2-10 amps,* 100 piv
CR_3 & $_4$, 750 mil, 100 piv
Ry_1 & $_2$, 250 ohm coils rated 12-24 volts dc
* Depends on number of control circuits which must be served simultaneously by CR_1 & $_2$.

The white serves unmistakable notice that the selected rig is on the air.

The real heart of the unit lies in the portion that sorts the power supplies, etc., which are required for each rig and performs all of the necessary switching operations. To keep the number of control circuits required down to a respectable minimum required digging into the bag of tricks and coming out with some dc relays, a handful of inexpensive low voltage silicon diodes and a 24 volt transformer. There are a number of advantages in the use of dc relays with quieter operation and longer life expectancy being the most important.

Referring to Fig. 2 you will see how one lead (plus a common ground) can be used with ac for the control voltage to handle either or both of two circuits. Of course dc relays will chatter plenty when operated on raw half wave ac unless something is done to prevent it. The chatter is caused by induction in the relay coils, so by adding CR_5 and CR_6 across the coils we provide a short circuit for this induced voltage but not for the supply voltage. For proper operation the ac voltage should be about 2½ times the normal dc operating voltage for the coils. CR_3 and CR_4 may be rated at about 60% of the normal coil current and CR_5 and CR_6 at about 40%.[1]

In many cases 1N34 type diodes will perform perfectly for CR_5 and CR_6. Occasionally, however, you may find a relay that will not quite operate properly using back-wave diodes at the voltage you have available and in these cases you can substitute a small capacitor (usually 50 mfd is adequate) for the back-wave diode. As a matter of fact you can use relays of mixed voltage ratings in this way, selecting your ac voltage to allow for all-diode operation with the relays requiring less voltage.

If relays for two different functions but operated by the same control lead are located close together on the same chassis, such as in the power supply application described below, the derivation of the circuit shown in Fig. 3 may be used. It provides the same control option as Fig. 2 but with a saving of two diodes. Putting the two relay circuits in series makes each of the diodes perform a double duty; as a polarity selecting rectifier for the relay above or below it and at the same time a back-wave diode for the relay that it is in parallel with. All of the operating conditions including the required voltage are exactly the same as in Fig. 2 as during any half-cycle of the applied control voltage one of the diodes provides a virtual dead short bypassing the relay coil that it parallels and passing the full rectified half cycle to the other coil.

Just a word in passing about the parts values indicated in the accompanying diagrams. Many of the diodes indicated are far in excess of the required ratings with their selection dictated by virtue of their being the cheapest size available locally at the time. However, as the current requirements of various relays may vary considerably and the availability and price of diodes varies even more, it is suggested that you check the bargain ads.

Using the configurations of Fig. 2 and Fig. 3 has proved highly successful for performing the various switching jobs for several rigs. There are a variety of power supplies in the rack at the home station, each of which is set up with two relays such as in Fig. 3; one relay to turn on the primary and the other to switch the output voltage to whichever rig is in use during transmission periods. The filaments for each exciter, amplifier, modulator or what have you are controlled using the Fig. 2 scheme, as are coaxial relays for rf switching. Of course, not all of the power supplies are necessarily in use for any particular rig as the requirements of particular rigs vary from some

[1] International Rectifier Corp. Engineering Handbook.

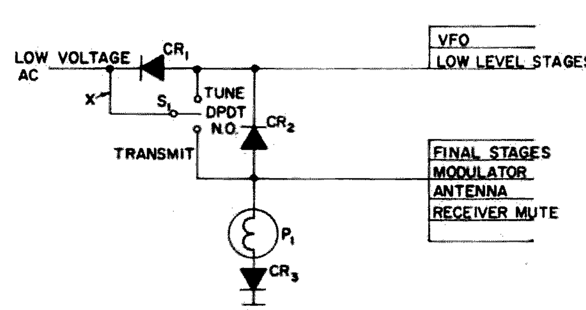

FIG. 4

Fig. 4—CR_1 & CR_2, 10 amp 100 piv
CR_3, 750 mil 100 piv
P_1 GE #313, 28 v
Lof voltage ac supplied by 24 vac, 8 amp transformer (surplus)

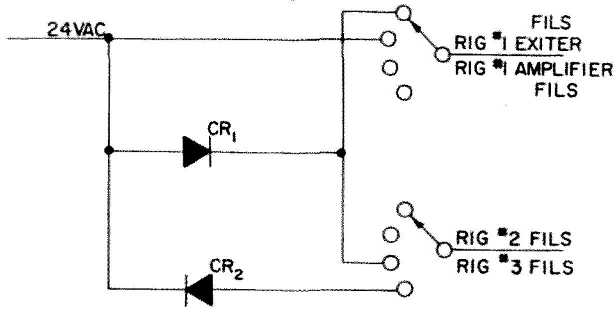

Fig. 5—CR_1 & $_2$, 2-10 amps, 100 piv amps rating determined by total number of control circuits to be served by this part of control system

low powered rigs requiring only one supply to more complex rigs which may require that particular supply plus two or three others.

Now the trick is to wrap all of these control functions together into a simple package that will allow one rotary switch to select the proper power supplies and filaments and do the necessary rf switching to put any of several rigs on the air Fig. 4 shows in block form just how easily this can be accomplished. To simplify the project, all of the power supply control relays have matched polarities; that is, the relays which turn on the primaries of the various supplies all require a negative half-cycle and the output switching is done with the positive half-cycle. CR_1 in Fig. 4 eliminates the

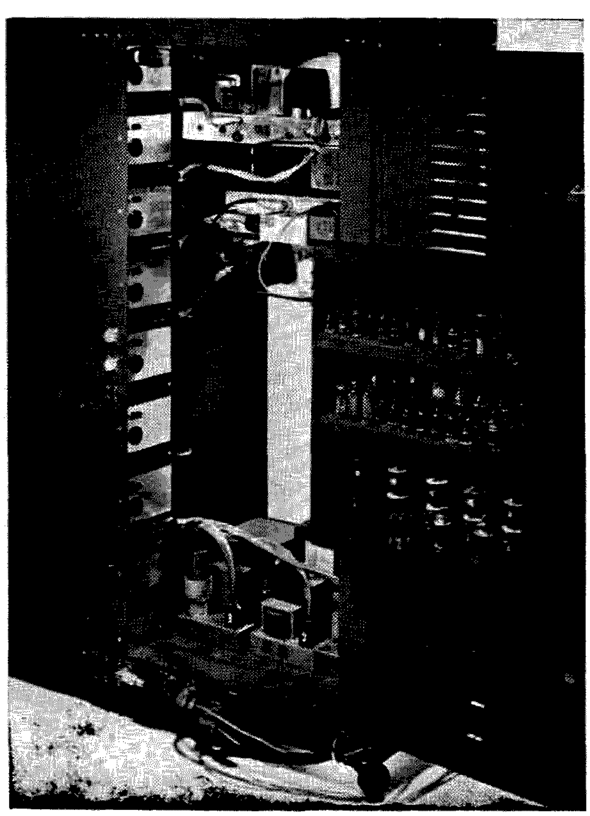

Fig. 6

positive half-cycle from the power supply control leads during the stand-by period. CR_2 is inserted between the functions which are to be turned on during tuning up and those which are to be turned on only during transmissions and provides a sneaky way of allowing S_1 to function as a tune-transmit switch. The pilot light shown indicates when any rig is on the air.

The control leads shown at the right hand side of Fig. 4 go to a rotary switch which has a number of sections, several sections of which switch these leads on or off as required for the particular rig which that position of the switch selects. This takes care of power supplies, antenna relay switching and receiver muting.

The filament circuit control, and other functions such as switching the output of an exciter from the antenna circuit to an amplifier input, requires a little different system and it is best for these circuits to use a separate section on the master rotary switch for each control lead connected as shown in Fig. 5 which shows a typical setup for one such filament control section.

Proper choice of the rotary switch used for controlling all these functions is very important. The number of sections required will, of course, depend upon how many functions must be performed. The switches that come in knocked-down form are ideal for this purpose as additional sections may be added later if required (if the index assembly is long enough in the first place). Since comparatively low voltages are all that will be handled by this control switch, the sections can be spaced quite close together.

Before going on to some of the little refinements, it's about time to tackle the haywire jungle. As a station grows, so, all too often does the amount of haywire wadded, stuffed and crammed in behind its otherwise well constructed units. An excellent way to dispose of great wads of wire is to make up a distribution strip such as shown in Fig. 6 (photo). Such a strip need be made up only of a number of multi-contact female connectors of any appropriate type, spaced at convenient intervals and connected together in parallel. Each power supply, exciter, amplifier or what have you is then fitted with an appropriate cable terminated with a matching male connector.

In the installation shown, the female connectors on the strip are 33 pin Cinch-Jones spaced on 5 inch centers. These connectors carry all of the control circuits required for several rigs and in additon the dc outputs of all of the power supplies (up to an including

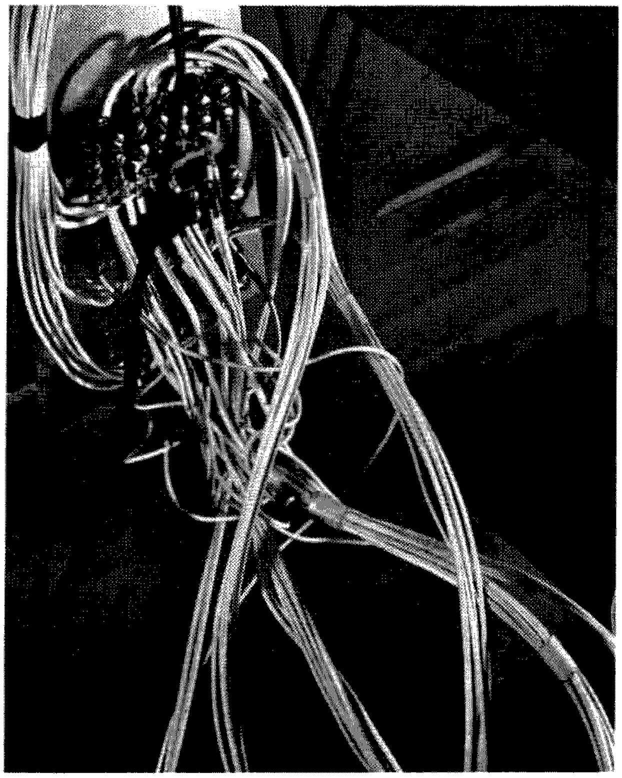

Fig. 7

500 vdc) as well as 110 ac for the primaries of the filament and other transformers. Bypassing can be done as required behind the strip, and the cables connecting the various units to the strip should be made up with shielded cable and well bypassed. The connecting cables shown are made up of individually shielded conductors, inserted in neoprene tubing. In between the 33 contact receptacles, ordinary 110 ac receptacles are included to accomodate any rack sections that do ot require connection to the control system and common power supplies and also to provide a handy place to plug in a soldering iron and/or test equipment during servicing.

Ordinary U-bolts, such as can be seen at the lower right corner of the outside of the cabinet and also just to the right of the distribution strip on the inside, are a very easy way to keep loose wires behind the cabinet from getting caught under the castors, and on the inside are a good way to keep the high voltage leads for the amplifiers, audio and rf cables back out of the way. The section shown open on the photo contains low level stages and power supplies, etc., with the adjacent section set aside for high voltage power supplies and amplifiers but with the control distribution for the two sections interconnected. So, before you start feeling smug, confident that you don't have need of any such at your station, just take a look at Fig. 7 (photo) showing part of the same section as shown in Fig. 6 before installing the

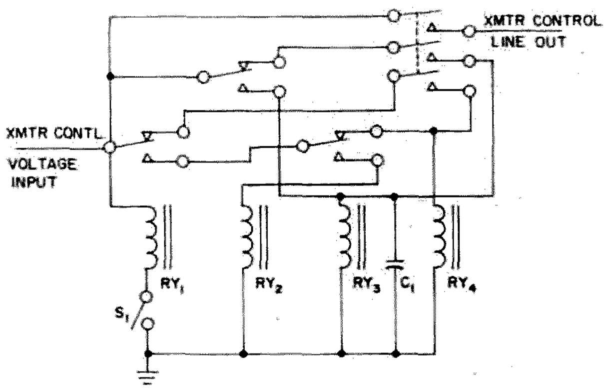

Fig. 8 Ry 1,2,3, spdt (NO)
Ry 4, 3 pst
C_1, see text
S_1, spst (NO) mike switch

distribution strip . . . remind you of anything lurking in your vicinity?

Don't panic at the idea of having male connectors on the output of power supplies; the ac input has to come in through the same connector with this system so assuming you have proper bleeders those pins are cold whenever they are not plugged in. Speaking of connectors, be sure when you select the type to use that you plan ahead and try to anticipate how many contacts will be required even when you finish that super band blaster you've been thinking about building.

Now that we are back in operation we can add some of those little extra conveniences back at the control panel. One of the handiest of them is a lazy mans push-to-talk that comes on with the first push and stays on till the second. Latching relays are the easiest approach, but leave much to be desired.

The circuit in Fig. 8 does the job very nicely, and if there is any interuption in the power during a transmission (such as a power failure or the tripping of an overload relay anywhere along the line) the relays are de-energized until the condition is corrected and the cycle restarted by pushing the button. It is more convenient to use all dc relays since

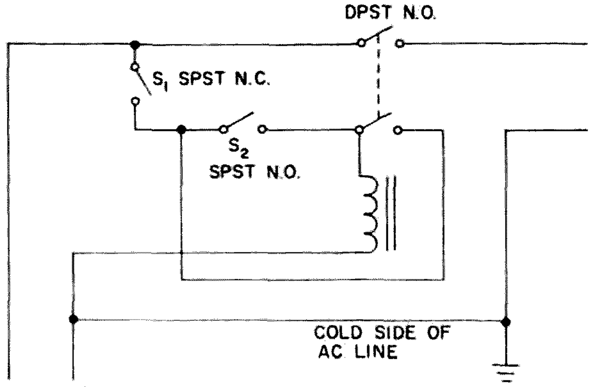

FIG. 9

RY_3 must be of the dc variety with a capacitor across the coil to hold it on during the switching time of the other relays. The value of C_1 will depend upon the relay used and will have to be determined experimentally.

Referring back again to the panel shown in Fig. 1, the failure indicator circuit is a nice little luxury utilizing some bargain relays. Two-bits each bought a bunch of dpdt hermetically sealed surplus relays that operate on 4 ma. One of these was incorporated (with a series resistor to drop the voltage) in the bleeder net of each power supply. The control voltage which turns on the primary of that power supply is also applied to the normally closed contacts. As long as this relay in the bleeder net is not energized the control voltage for that power supply is switched to a failure circuit which in turn energizes a relay back at the control panel. This latter relay interrupts the control circuit at point "X" in Fig. 4 so that the transmiter can not be turned on until all of the power supplies required reach operating voltage, or cuts off all of the high voltages in case of a failure or overload in the middle of a transmission. The resistor in series with the bleeder relay should be adjusted so that the relay will just hold under normal operating load on that particular supply. A failure bypass switch has been provided on the panel in case it should ever be useful.

The master power switching is done by the two push buttons shown at the left side of the panel. These in turn operate a *heavy duty* relay with contacts more than adequate to handle any size rig. The exact specifications for the relay(s) used for this purpose will depend entirely upon the individual station and whether it is fed by 110 or 220 vac, etc. However, the general wiring scheme is shown in Fig. 9. Separate contacts should be used for the main line and the circuit to hold the relay(s) closed to prevent putting the whole starting surge across the push button.

The stop button should be well marked and placed where the XYL can find it in a hurry . . . just in case.

It probably looks like a lot of work to go to, and it is. But the next time your rig sends up smoke signals and you start fighting that copper jungle to get at it, or you go through a long ritual when changing over from one rig to another, stop and think about what you can do about solving the problems in your station. Better yet don't wait for your next crisis; do it now and then settle back for some real relaxed hamming.

. . . WB2CCM

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DSB Circuits

There are several ways of providing audio to modulate double-sideband transmitters. All of them have been mentioned in amateur publications, but not all have been widely used.

Fig. 1 shows the most common DSB arrangement. The transformer, T1, can be a Triad A31X or a Thordarson 20D76. A power transformer can also be used. By using the plate winding of the transformer to drive the screen grids of the DSB tubes, an approximately 3:1 or 4:1 (or higher, depending upon the characteristics of the power transformer) step-up is accomplished. The writer has used this system, and the audio quality is quite good.

Another method uses a cathode follower arrangement, as shown in Fig. 2. Depending upon the tubes employed, about 150 volts can be realized at the screen grids of the DSB tubes, which is adequate when using the smaller receiving-type tubes in a low-level DSB balanced modulator.

A system the writer has used for some time with considerable success and excellent audio quality is shown in Fig. 3. This system assumes the existence of an AM transmitter, and uses both its rf and audio outputs. The big problem, of course, which prevents use of conventional modulation transformers in most DSB applications is the lack of a secondary winding center tap. That lack can be overcome by using rectifiers—either tube or silicon—connected across the secondary as shown in Fig. 3. These rectifiers, with the balanced modulator tubes, form in essence, a bridge circuit so that both the positive and negative peaks cause audio voltage to be applied to the balanced modulator screens. We have used both tube (6X4) and silicon rectifiers with equally good results. The modulator in the author's AM rig is rated at approximately 60 watts output, which is, obviously, many times more audio than is required for the screens of the DSB tubes, so resistor R1 is placed across the secondary not only to absorb the excess audio power, but to provide an adequate load for the transformer. In the case of the illustrated transmitter, a 10-watt, 4000-ohm wire-wound resistor is used, and the audio gain on the AM transmitter kept very low. Because of the limited amount of audio allowed to reach the modulation transformer, and because the power output of the transformer is intermittent, the 10-watt resistor shows no signs of overheating except on the application of a continuous tone over a period of about one minute. The audio circuit of the transmitter was designed to minimize lows through use of small coupling capacitors, and

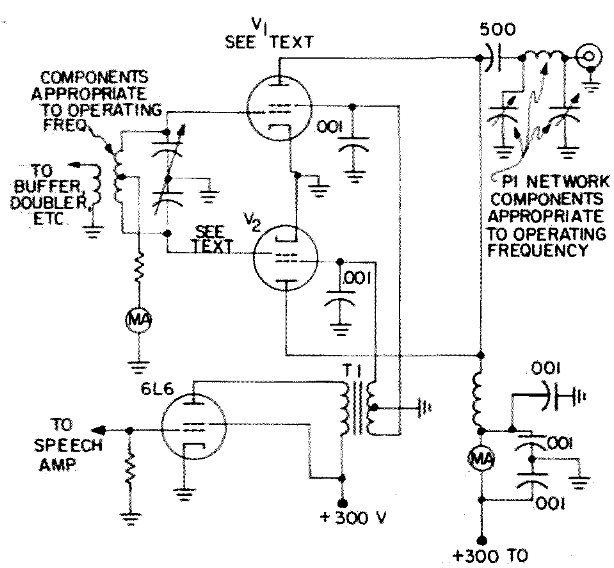


FIG I BASIC DOUBLE-SIDEBAND CIRCUIT

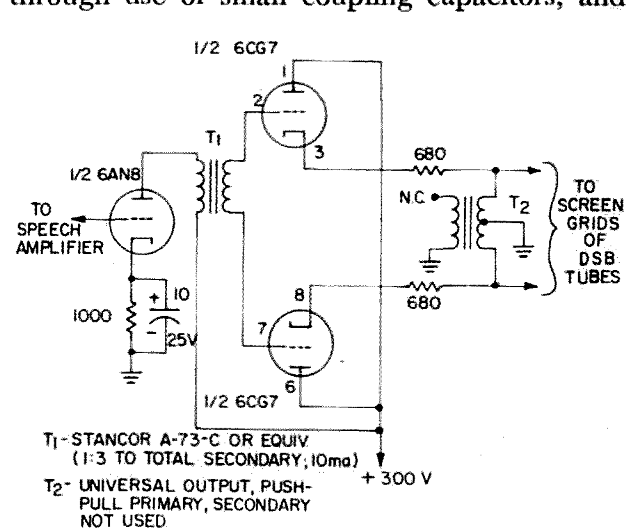


FIG 2 CATHODE FOLLOWER AUDIO SYSTEM FOR DSB TRANSMITTERS

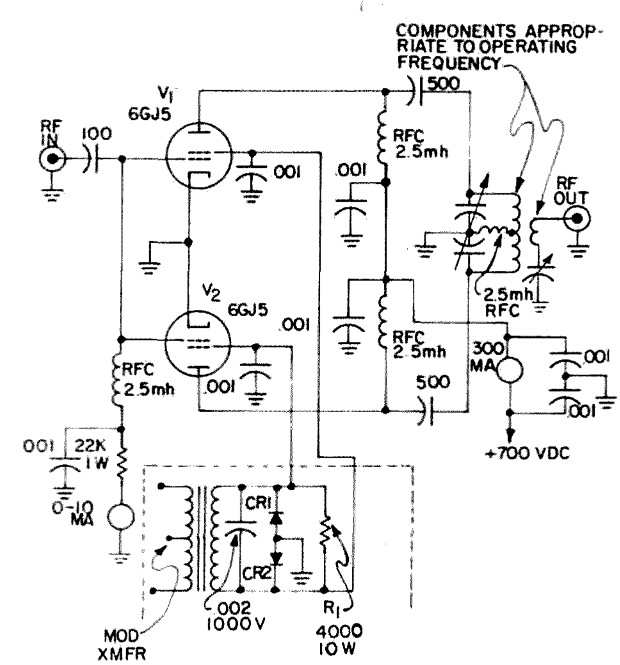


FIG. 3

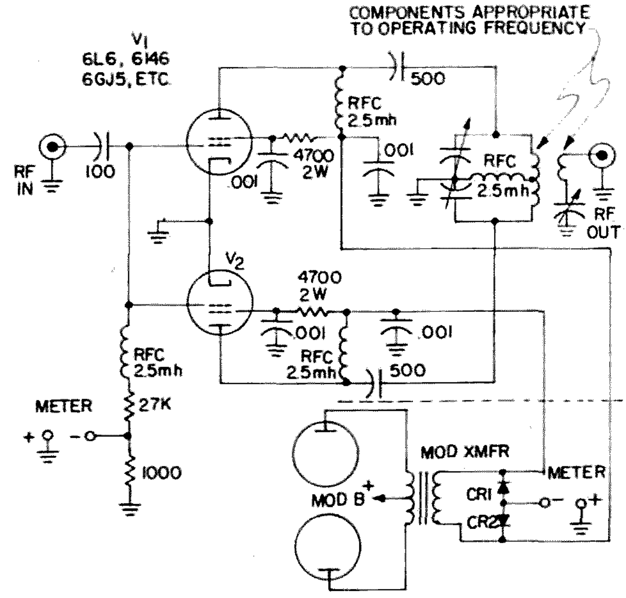


FIG. 4 HIGH-LEVEL DSB BALANCED MODULATOR

the capacitor across the secondary of the modulation transformer reduces highs.

The use of auxilliary rectifiers was described by Rockafellow *, as was the next system to be described. Fig. 4 illustrates a high-level double-sideband balanced modulator which obtains both plate and screen voltage from the modulator contained in an existing AM transmitter. The rf drive is also obtained from the same transmitter. The only problem encountered by the writer in using this system was that the voltages measured from one end of the secondary to ground (at the rectifiers) and from the other end of the secondary to ground were not equal upon application of a single tone to the modulator. The result was unequal voltages to the screens and plates of the DSB balanced modulator tubes. Consultation with an engineer more learned than the writer resulted in the conclusion that this effect was caused by one end of the secondary winding having a larger capacitance than the other end to the primary winding. Various values of capacitance were tried between the individual ends of the secondary and primary windings and the situation was noticeably improved with the use of 160 mmfd between one secondary terminal and a primary terminal.

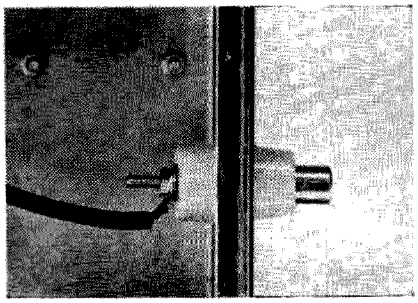
An important word of caution. Although DSB is an easy way to "get on sideband," it still requires care in the construction and operation of the equipment. Before you put any piece of DSB equipment on the air, *look at the output with an oscilloscope*. Beg, borrow, or steal one, but use a 'scope. With a single tone from an audio oscillator as the audio input, load the transmitter as heavily as possible and observe the pattern on the scope. It should be the familiar "two-tone" (if it isn't familiar, then refer to any recent A.R.R.L. Radio Amateur's Handbook!) pattern. Increase the audio gain and note the point at which the peaks flatten. (Remember that a single-tone DSB signal will produce the same pattern on an oscilloscope as will a single-sideband two-tone signal.) Then connect a microphone and talk. You will find that the same peak on the oscilloscope achieved under single-tone modulation will be reached with your voice at a plate current meter indication of between one-third and one-half the single-tone plate current reading. It is at this point where some DSB operators run into trouble. Many try to "talk up" the plate current meter to the point at which they would operate under CW or AM conditions. It simply cannot be done without flat-topping, which results in distortion and splatter.

Remember, too, that to a linear amplifier, a DSB signal is the same as a two-tone SSB signal, and flattening of the peaks, and consequent distortion and splatter, will occur at a lower plate current meter reading than would occur with a single-tone SSB signal. The efficiency of a linear amplifier is lower in the case of a two-tone SSB or single-tone DSB signal (around 50% is all that can be expected) which may be a good argument for using high-power, high-level DSB modulators, with their excellent Class C efficiency, if you plan to run much over 200 watts PEP input.

. . . W6TKA

* Rockafellow, "High-Level Balanced Modulator for D.S.B." QST, April, 1960.

The Zorch-Proof Connector



Roy Pafenberg W4WKM

Interconnection of high voltage points in high power transmitters poses several problems. Factors to be considered include adequacy of insulation, appearance, availability of materials and—most important of all—safety. The photograph shows an excellent method of making such connections between chassis units.

A ceramic feed-through insulator of adequate voltage rating is mounted at the high voltage terminal point. The feed-through stud nut on the external connection end of the insulator is replaced with a ⅜" diameter, internally threaded ⅜" to ½" long round metal post. A standard, ceramic insulated tube plate clip is then used to complete the connection. Suitable plate clips are manufactured by several firms. Of these, the National Radio type SPP-3 is perhaps the most widely available.

The round metal posts may be made from rod stock or may be purchased. Internally threaded, round metal posts in ⅜" diameter were not found listed in the parts catalogs. Various firms stock round, ⅜" diameter, cadmium plated brass posts with unthreaded clearance holes. It is a simple matter to tap the screw clearance hole to accept the stud used in the feed-through insulator. The following listing gives Herman H. Smith part numbers for ⅜" and ½" round posts:

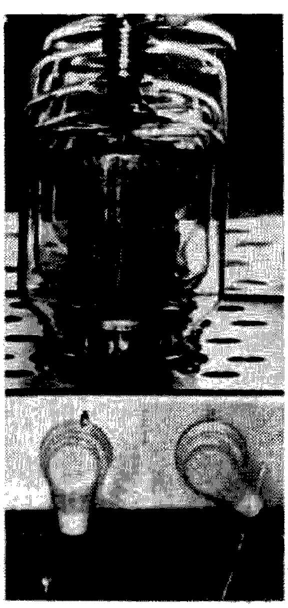
	Clearance Hole		
Length	#4	#6	#8
⅜"	2346	2111	2116
½"	2347	2112	2117

Cable used to interconnect the plate clips must be suitably insulated. Automotive spark plug cable is one possibility; TV high voltage lead another. Probably the best cable for this use is neon sign cable. Known as UL type GTO-15, this cable is rated at 15 kilovolts. Because of its high voltage rating, easy availability and low cost, this cable is widely used in commercial transmitters.

The technique described above is not limited to chassis interconnections. Many high voltage components use threaded stud terminals which lend themselves to this treatment. Simply thread on the round posts and complete the wiring with tube clip terminated high voltage patch cables.

The wiring method presented here is not intended for use in exposed locations. *Always* house high voltage circuitry in interlock protected cabinets. However, it is sometimes essential that equipment be tested with power applied. In such cases, exercise the greatest caution and stay clear of the high voltage circuits. This improved insulation system will then serve to minimize the danger of inadvertent contact with exposed high voltage points.

. . . W4WKM



The Zorch-Proof Connector at work.

John Bell W5NGX
2549 East 10th St.
Odessa, Texas

A Full-Wave Bridge With One Filament Transformer

Recently, while searching around for components to be used in a medium high voltage power supply, 1200 to 1500 volt class, this bridge rectifier circuit was dreamed up to use with the components on hand. A 750 volt, each side of center tap, plate transformer, and TV damper tubes, for rectifiers, in a bridge rectifier circuit, to give the desired higher voltage, for more efficient operation of our linear amplifier in SSB service. This bridge is very unique in that it uses only one filament transformer.

Silicon type rectifiers were first considered, but they have their own particular drawbacks, and are expensive, when it is considered how many it would take in a series arrangement in each leg of a bridge circuit, operating at these voltages. Tube type rectifiers still seem to be the best bet in this circuit, but using 816 or 866 tubes requires the use of three filament transformers, so cathode type tubes were considered. The ideal tube should have its cathode separate from, and be independent of, the filament. The half wave rectifier tubes developed for TV damper service fill this requirement, and have been used in high voltage power supply circuits many times by amateurs. Several articles have appeared in the ham publications in recent years using these rectifiers in bridge circuits. Practically all of these circuits use a 5U4 tube for one half of the bridge and TV damper tubes for the other half of the circuit. This arrangement is commonly known as the "economy power supply," and uses a TV set power transformer with a bridge rectifier circuit to get twice the output voltage, as you would with a full wave arrangement. Around 700 volts can be obtained from the economy supply, using a power transformer from an old TV set, and its schematic is shown in Fig. 1. One objection to this circuit is that it takes two filament transformers, one of 5 volts or the 5U4, and another of 6.3 volts for the cathode type recti-

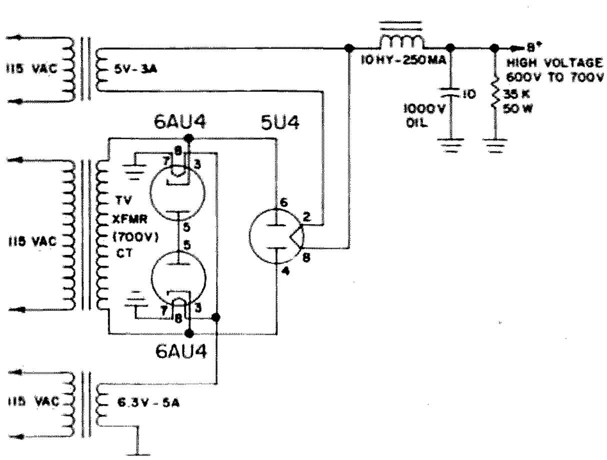


FIG. 1

fiers. This is definitely an improvement, in our way of thinking, for a bridge circuit, but we are faced with the problem of needing two filament transformers.

Since the TV damper tubes work so well in the arrangement in Fig. 1, and this set-up has been in use many years, so is pretty well proven, there is no reason why the TV damper tubes can't be used for the other half of the bridge circuit, provided they have sufficiently high enough voltage ratings. Since the TV damper tubes have a cathode in them, separated from the filament, our problem of the multi filament transformer is solved, as shown in Fig. 2.

Searching through the receiving tube manual, our choice of rectifier tubes is the 6AU4GTA. The main rating we have to look for here is the breakdown voltage, from heater to cathode. The tube manual gives it as 4500 volts, and that is about three times the voltage we plan to use in our power supply, so this tube should suffice. Now, another rating to consider: Maximum operating plate current, and it is 210 ma, which is a little under the maximum peaks, pulled from the supply, but well above the average value. So, from the tube manual, this tube fills our bill for a good rectifier, with a separate cathode. Another damper tube that would be OK for a rectifier in this circuit is the 6DE4. It actually has a higher heater to cathode breakdown voltage rating, but the average dc plate current rating is only 180 ma, therefore the 6AU4GTA is still the best tube, with all factors considered. Actual voltages are as follows: The transformer secondary ac voltage is 1530. With the bleeder current and static plate current being drawn on the linear amplifier, output voltage is 1430 volts dc. On voice peaks the meter on my linear amplifier indicates 350 ma and the voltage drops to 1350 volts dc, which is fairly good voltage regulation, with only 8 mfd of capacity on the output of the power supply. More capacity could be added and even better voltage regulation could be achieved; however this holds true for any power supply, regardless of the type of rectification used. Another hint is to use a good, stiff bleeder resistor. If a power supply has a good, constant load on it, the regulation will be much improved, when higher current is drawn, plus the safety factor of discharging the filter capacitors when the power supply is turned off.

The only other thing that is a little different about this power supply is the placement of the filter choke in the negative lead. It is not anything new, but is a little uncommon. This

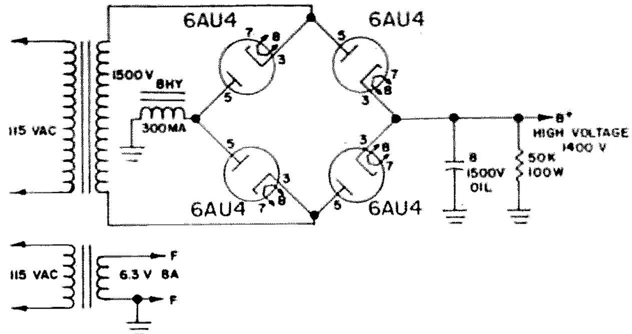


FIG. 2

was done so a choke of a lower voltage breakdown rating could be used. This particular one used here has a rating of 8 hy at 300 ma. A choke manufactured for use in a TV set could be used in this way, because the actual high voltage is not on it, as it is when the choke is placed in the positive lead. It is still considered to be a choke input filter however.

Money-wise, this type of supply beats all other types, we think. A transformer with a rating of 750 volts each side of center tap, costs about one third the price of one rated at 1500 volts each side of center tap. Rectifier tubes: The 6AU4GTA cost $1.80 ham net, on the current tube price list. And of course the big savings is in the filament transformers: Only one against three in a conventional bridge circuit, or two, in the economy type supply, shown in Fig. 1.

I fully expect some rebuttal from readers of this article, telling the many reasons why it won't work, but I would welcome any constructive criticism. This power supply has been in use here for several months now, and I have never had one bit of trouble with it. My linear amplifier uses three 837's in a grounded grid circuit, and I drive them to 350 ma on peaks, with a Central Electronics 20-A exciter. I have never once been given a report of flat topping, hum or distortion being noticed, or any of the other things that could be caused by power supply troubles.

In closing, I would like to say that this is an excellent power supply; as good as any that I have ever had in my shack. Also, I would like to mention my two good friends, W5SHL and K5FMJ, who have built up similar type power supplies, and their units have worked equally well with voltages up to 1900 volts.

This power supply was designed for Single Side Band operation, with high peak currents drawn from it, with a relatively low average value. For constant current service, with current requirement higher than the capabilities of the tubes, it is definitely not recommended.

. . . W5NGX

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A Cheap SWR Bridge

The unit to be described in the following paragraphs is not "just another SWR Meter" but is designed to be easily duplicated, and it makes use of a printed circuit board for the critical part of the unit.

As can be seen in the photo of the interior, the section of line that is used for indication of SWR is made up of a section of double sided printed circuit board at the suggestion of WA1CCH. On one side can be seen the portion of line that is connected between the input and output coax connectors. Also on this side may be seen the diodes, bypass capacitors, and the load resistors. On the reverse side of the board are the two pick-up loops that provide the indication of forward and reflected power.

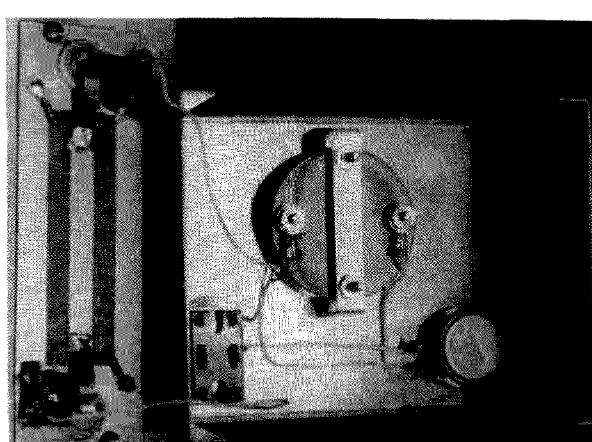
On the front panel of the unit are mounted the meter, calibrating resistor, and the selector switch. It may be noted that the switch I used is a DPDT. This is because it is what I had available at the time. All that is necessary is a SPDT type. The calibrating resistor is a 10 k to 50 k pot. The meter I used in my version has a special scale that is calibrated in SWR ratio, but you may use a 0-1 ma meter and use the chart below.

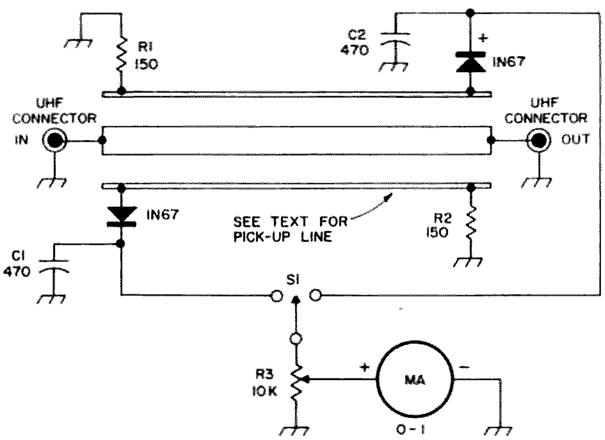
Inside view of the SWR Meter. The special pick-up line at left is available inexpensively. See end of article for details.

Following is the calibration for the meter specified in the parts list.

Meter	SWR
0	0
10	1.25
20	1.5
33	2.0
50	3.0
60	4.0
66	5.0
72	6.0

The above will only hold true if the meter is adjusted to exactly full scale in the forward position.





Schematic diagram of SWR bridge. Pick-up line is available from Harris Co.

Parts List

Cabinet	Premier AMC 1005 (5x4x3)
Meter	Similar to Shurite 850 (0-1 ma)
Diodes	1N67
R1, R2	150 ohm
C1, C2	470 pf
R3	10 k to 50 k
S1	SPDT
Coax fittings	Regular UHF type
Misc Hardware	

Once connected into the antenna system of your station, operation of the unit is simplicity itself. All that is necessary is to flip the switch to the forward position and then adjust the calibrating control for full scale deflection of the meter. The switch is then placed in the reflected position and the SWR is read directly from the meter scale.

If you find that your SWR is much higher than 1.5:1 I suggest that you inspect and adjust your antenna. Remember that the SWR can be reduced only by adjustment or trimming of the antenna. It can never be reduced by adjusting the transmitter. . . . W1JJL

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Slowing Down the Tuning Rate on the Drake 2B

Users of the excellent Drake 2B may now slow down the tuning rate by a factor of 6 to 1 without modification of the receiver. The method described here permits the use of a planetary gear drive to reduce the normally fast tuning rate to a point where, for example, the 7200-7300 section requires 14 turns of the tuning knob. This figures out to be about 7 kc per tuning knob rotation! Yet there is NO backlash, the tuning is smooth and even, the calibration is not disturbed, and the band spread is something wonderful!

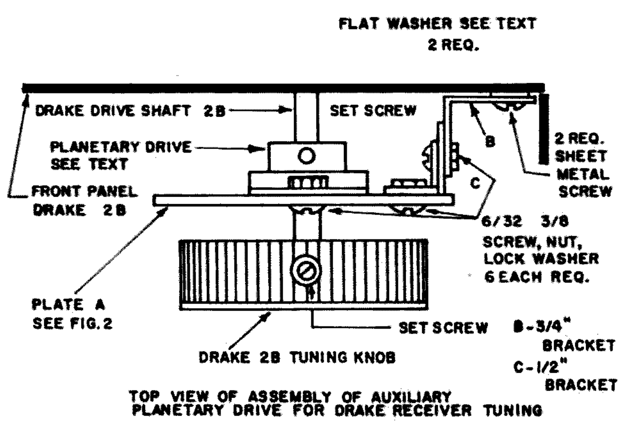

FIG. 1

The introduction of the Jackson Bros. (England) planetary drive made this possible. This device, a ball-bearinged precision drive, is available from Arrow Electronics Inc. (900 Broad Hollow Rd., Farmingdale, N.Y. and other of their stores) for $1.50 each.

A plate, see Fig. 2, is made to hold the Jackson drive out from the panel. See Fig. 1. Four brackets, six screws and two longer sheet metal screws are required (the latter to replace the two screws normally in the right hand side of the Drake 2B). Remove the normal Drake 2B tuning knob.

Remove the two sheet metal screws at the lower right hand corner of the front panel. Mount the plate, with the Jackson drive fastened in place, using two small flat washers to protect the panel from possible scratching by the bracket—or smooth down the bracket edges, and carefully align the drive mechanism to permit smooth operation of the drive shaft on the existing bearings, when the Jackson drive is in place. Fasten the screws holding the plate; drive and panel tightly. Replace the Drake knob. Tape the removed Drake screws in a safe place for replacement, if desired.

This modification is worth while and simple. It does not violate the "Guarantee", and the original state of the receiver may be obtained in a minute by removing the plate and restoring the knob. If you desire to do so, a simple inspection of the inside mechanism of the Drake 2B will reveal how the Jackson drive may be installed permanently.

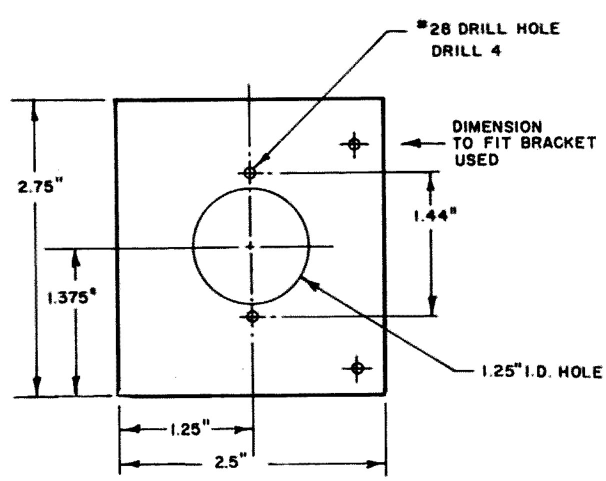

FIG. 2 PLATE - MATERIAL 1/16" METAL OR 1/8" BAKELITE STOCK

Try this. You will be amazed at the ease with which you can now tune in signals, effortlessly and without the "flywheel" effect. The planetary drive adds firmness, yet does not add any backlash, and it spreads them out!

. . . W7ZC/W5CA

Wayne Green W2NSD/1

W2NSD in Europe

A little while ago I shoved the accumulated work on my desk aside and turned on the receiver to see what was around on twenty. I'd just gotten a DX bulletin from Puerto Rico which mentioned several exotic stations that should be active . . . perhaps one of them would be around. Nope, not much doing . . . fairly quiet this afternoon. Oh, oh . . . UA3KBD in Moscow signing with someone in Africa. I gave him a short call . . . I'm 5-9 in Moscow. We talked for about fifteen minutes and then signed . . . and there was Janos HA5AM in Budapest calling me.

Back in May I visited Budapest and had a wonderful time talking with Janos and the other members of the Central Radio Club. They even invited me to use the club station for a few QSO's! I remember my state of mind as I crossed the border into Hungary from Austria, driving my VW. I was pretty worried . . . I didn't know what was expected of me, or what would happen. At the border no one spoke any English, which didn't help matters. Further, I didn't even have a visa to get in the country. And in my pocket was Hungarian currency that I had been sold cutrate by the Austrian border guards . . . illegal currency.

The soldiers with guns, heavy gates across the road, and other unfriendliness contributed to my state of mind. Several times as I neared the border I thought seriously of turning back. I didn't know if other people worry themselves over things the way I do . . . I wonder if I have enough money along . . . enough of the local currency . . . will I have car trouble . . . run out of gas . . . do something wrong . . . have an accident . . . not be able to find the people I'm going to visit . . . etc.

I waited at the door of the customs building for some word from the official that had disappeared with my passport twenty minutes before. It seemed impossible that here I was on a major border crossing point between Austria and Hungary and I was the only person crossing that morning. Suddenly a cuckoo clock started sounding somewhere in the distance . . . followed by another. I startled the guards by laughing when I suddenly realized that those were cuckoo birds I was hearing . . . the real thing.

Soon my visa was ready and, passport in hand, I started off toward Budapest. Hungary could just as well be parts of New York or Pennsylvania with rolling mountains and flat plains. It was beautiful and I soon gathered courage. The big difference is in the houses and lack of cars. There are bus stops every mile or so along the road, but hardly a car. Now and then I would pass a bus or government truck . . . an ox cart or horse-drawn cart. As I approached towns I had to be careful of groups of people walking.

About twenty miles inside the border some soldiers guarding the road flagged me down for just a moment . . . the same thing happened on my way back out of the country so I suppose that they have all roads guarded to keep people from getting close to the border unless they have business there.

The road was fine . . . about the same as one of our small county roads in New Hampshire, so I perked along at 60-70 most of the way. In the European tradition all of the houses were in village groups. You rarely see a house out in the country in much of Europe. Almost all of the houses in the villages faced small dirt (mud) roads of either side of the main highway. No stores much, no restaurants, and nothing even remotely approaching a road-side stand selling anything.

As I drove I ruminated over the self-destructive urge that had brought me to Hungary in search of HA5AM. Why not stay in Peterborough where everything is completely familiar? Why ulcerate myself venturing into something as unknown as this? And what will happen? These people are friendly enough, I guess, but they speak virtually no English and not even any French. If I have any problems it is going to be rough. And I'm sure to have problems for I have managed to lose all but a very old address of HA5AM's. Janos is one of our subscribers in Hungary, so I dropped him a letter a few weeks back explaining that I would be visiting. Just a few days before my departure Janos called me on twenty meters and said he was looking for me. Naturally I left without his address. Great, eh? In Stuttgart I got an old address from a DXer. In Zurich I talked with my home station from HB9RG and got his new address . . . and I lost it almost immediately. In Geneva I forgot to look in a Callbook. Hmmm.

Along about five o'clock I arrived in Budapest (Budapesht, they pronounce it) and stopped at a newsstand to try to buy a map of the city. My sign language was successful and the woman pointed at a nearby stationery store. A few minutes later I found the old address. I asked a woman at the house for Janos . . . no. She called to a fellow that was just leaving and fortunately he knew enough English so I was able to explain my problem. He asked around . . . no. Then we tried the phone book . . . aha, two Emmer Janos's. I drove him to his apartment and he phoned for me . . . and found Janos, who gave him instructions. After a glass of wine, a look through his family album at pictures of his wife and children, and a tour of his apartment we left and he directed me to the Central Radio Club a few blocks away. Janos was there waiting for me and the chap, obviously very pleased to be of help, excused himself and quickly walked off.

Janos took me in and introduced me to the half dozen or so hams gathered for the regular Friday night club meeting. Fortunately most of them spoke English quite well and we had a wonderful rag chew. Also visiting that evening was Fred DM3RM from Eastern Germany and George WØUXQ. George offered to put me up in his hotel room for the night . . . apparently hotel rooms are hard to come by here . . . and I readily agreed, realizing that I would probably learn more about Hungary from this veteran than any other way.

The Central Radio Club has its own club building, complete with an old army transmitter which looked like it could put out several kilowatts (shades of California). It seems that Radio Club members are able to get cast off equipment from the airlines, busses, PTT, taxis, police, etc. This is one advantage of having all the communications owned by the State. Just think what our ham stations would be like if we could get all the replaced gear from all the various users in our country! Say, what does happen to old broadcast transmitters?

George and I went to the hotel and had dinner about 9 p.m. George, being an expert at these matters, had no problem in waving off the girls who wanted to share our meal (and evening) with us. Lucky for me I was with him or else I might have had to endure the company of a beautiful blond (English speaking) girl for the night.

Dinner was good, but expensive, costing about $8 for the two of us, wine included. The hotel caters to foreign visitors so their prices are quite high by Hungarian standards.

Our country, in an attempt not to help the Russians any more than possible, has a pretty tight embargo on electronic equipment to Russia and the satellite countries. George is a salesman for Wilcox and has managed to break this barrier and sell some of their airbourne equipment to several of the iron curtain countries. He was in Budapest for a few days to exhibit his equipment at the Budapest Fair.

We talked until after midnight and I gathered that he has great hopes for increased understanding between the east and west and a healthy growth of trade. It seems to me that the U.S. would be very clever to subsidize the manufacture of small inexpensive automobiles for sale at a low price to Hungarians. This could change their whole economy and, I believe, perk it up tremendously. The auto industry is one of the foundations of the U.S. economy . . . it could be elsewhere. Judging from how hard the Hungarians work for their extremely expensive tv sets, I think they would work around the clock for cars . . . gas to run them . . . and it could change everything. Typical American reaction, I suppose.

We got up early the next morning, the usual coffee, rolls and jam European breakfast and

then out to the Fairgrounds. The day was rainy and dark . . . bah. I wandered around the fair for a while, looking for things to snap with my camera, but the dark and rain didn't encourage the expenditure of much color film. Suddenly I came on the U.S. exhibit. Naturally I went in to see what kind of stuff we were doing to sell the United States to the Hungarians. The exhibit was a gigantic garish affair mostly taken over with big ads for how rich we are . . . hundreds of pictures of our big tv sets, cars, lavish homes, kitchens, appliances, furniture. I suppose that we do have a few people that can live like that, but darned few that I've met. They had a $1000 hi-fi and one of those $250 easy chairs in the "typical" living room . . . the hi-fi was blasting out a demo tape. One each of the popular brand cars were lined up outside the exhibit. They even had a ham station set up . . . well, piled up, for it was all just thrown in a small booth with nothing hooked up. The poor Hungarian in charge of the ham exhibit knew absolutely nothing about the equipment and was pathetically eager to know what it was all for, how much it cost, who used it, etc., so he could answer the fair goers questions. I understand that a license had been applied for and almost came through, then the Viet Nam difficulty upset things. From what I could gather from the people at the fair the U.S. exhibit is one that travels from fair to fair with two Americans running the whole thing . . . one a fat arrogant loud mouthed cigar chewer and the other an insignificant mouse who was unable to make any decisions. Feelings ran quite high against them. Makes you proud to be an American.

Not knowing the language at all I was afraid to plunge into one of the chow lines in front of the food stalls. Perhaps George would help me through this hurdle. Fair-ly well pooped I went back and grabbed George at about 2 PM and we headed out for lunch. He went right by the food booths, in spite of my plucking at his sleeve. He knew a better place nearby. We passed people working on big plates of shish kabob, goulash, and other unknown but interesting dishes. We walked and walked and walked. Hmmm, here it is, but it is too full. We went on for another half mile to a restaurant set up for the exhibitors where they had particularly poor but expensive food for the foreigners.

It was late in the afternoon when we got back to George's exhibit. We found that OK1MB had been there while we were gone and would be back in a half hour. I was distraught at missing Beda, the best known OK ham in the world, but I was going to be late for an appointment with another Hungarian ham in a small town about 80 miles away.

I bid George goodbye and thanked him for making my visit to Budapest so educational and entertaining. I drove back to the hotel, checked out and asked for my passport. Oh, sorry, come back at 3 PM. I said it is now 4:15 and I am late, what do you mean come back at 3? Oh, you are leaving? Yes, may I have my passport. Wait a moment please. Finally, after a couple phone calls, they sent a bellhop with me to the police station several blocks away and I got my passport. Some society.

Since I was a little low on gas I drove a few blocks to where I had seen a state owned gas station. Sorry, all the gas has been sold out for today. Oi. I drove on to another that I remembered passing . . . long line waiting there . . . I'm going to be late, I can see that now. I parked at the end of the line and walked up to the front to see how much it was and if I could buy enough with the money I had left. They looked at me and back at my car and somehow got through to me that I needed super and all they sold at this station was regular grade. I remembered that the VW people had explained that I must use super at all costs in the communist countries. They explained that I would have to get super down by the railroad station. OK. I drove back to the station, across the street from my hotel, and located the super pump by the long line waiting for it. It was 5 PM by now and I could see that I definitely was going to be late meeting Harry in Gyor.

About a half hour later I finally made it to the pump and was ready to go . . . about 50¢ a gallon. I drove through the center of Budapest, over a bridge, and found myself out in the country. I put my foot down, hoping to make the two hour trip in 1½ hours and arrive about on time. There was little traffic . . . with the least expensive cars costing about $5000 and salaries running about one fifth of ours it is easy to see why there are not many privately owned cars yet.

By not slowing down too much going through towns I managed to arrive at Gyor three minutes early. Harry was waiting for me in the appointed spot.

We parked my car and walked around with him showing me the town. He told me how he had been with the freedom fighters back in 1956 and as a result would never be able to get a ham license again. He felt bad about the loss of his beloved amateur radio and the fact that he would never be able to leave the communist countries or rise to any important position, but philosophically shrugged it off with

the observation that at least he was alive, something not many of those involved could say.

He and his wife treated me to a wonderful dinner, then we went out for coffee, back home for cakes and talked until 1 AM. They fixed up the couch for me. Fortunately I was not far enough to the north to worry about having to entertain the wife after lights out, a delicate problem which one can stew over if he has a vivid enough imagination and his host has a lovely enough wife.

Up at 7:30 . . . a quick hot chocolate . . . a warm goodbye and off I go through the continuing rain. A few minutes later I arrived at the border and, after about 15 minutes of paperwork and a careful inspection of the car I was breathing sighs of relief as I entered Austria.

Now that I've been there I wouldn't hesitate to go back. The people were universally friendly . . . those girls in the hotel might have been friendly too. But next time I want to get there when the sun is out and bring back color slides of lovely Budapest to show you at clubs and hamfests. If you run into any of the HA5 gang please say hello for me.

. . . W2NSD/1

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The Compactron Two Meter Transmitting Converter

The success of the six meter crystal-VFO transmitter described in the April 1965 73 suggested that the same type of system might be very useful of two. So I built one using Compactron tubes to go with the six meter exciter. It has worked very well. The block diagram, **Fig. 1**, shows how it works. The left section is the exciter from the six meter rig. The next part is the heterodyne mixer to two meters. Then comes a 5763 buffer amplifier and a final 7984 Compactron with the modulator from the six meter rig.

A description of the converter circuit

Fig. 2 is the schematic diagram of the exciter. The first triode section of the 6AF11 is used as a 47 mc crystal oscillator. Regeneration is used to increase the output, the ease of starting, flatten the power-output curve on the capacitor and make the circuit less critical.

The output of the oscillator is fed to a doubler which is the other triode section of the 6AF11. The 94 mc output of the doubler is fed to the control grid of the pentode section of the 6AF11.

The 50 mc output from the six meter exciter is fed to the screen grid of the pentode mixer. This is screen grid modulation. Note the 50 mc link-coupled tuned circuit L5-C3 which couples the six meter rf to the tube.

The pentode mixer plate is tuned to 144 mc. Output from this mixer will burn out a number 48 pilot lamp (120 mw) if the plate voltages are pushed a little. However, I wanted a stable signal so used only 80 volts on the oscillators and added an extra stage of amplification to increase the drive to the final.

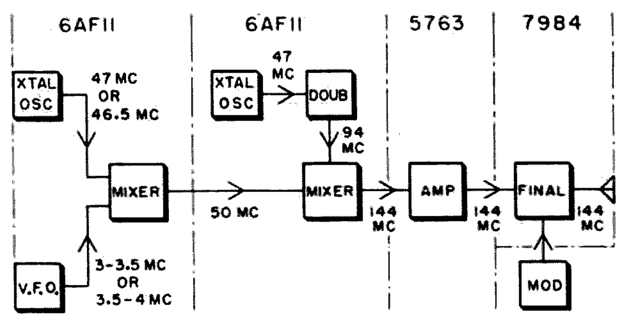


Fig. 1. Block diagram of the two meter VFO rig. See test for explanation.

The power amplifier

Now that I had a stable low-level two meter signal, I began looking for a good Compactron power amplifier. The TV horizontal output tubes were tried first, but handled very poorly at VHF. That came as no surprise since they're designed for 15.75 kc, not 144 mc.

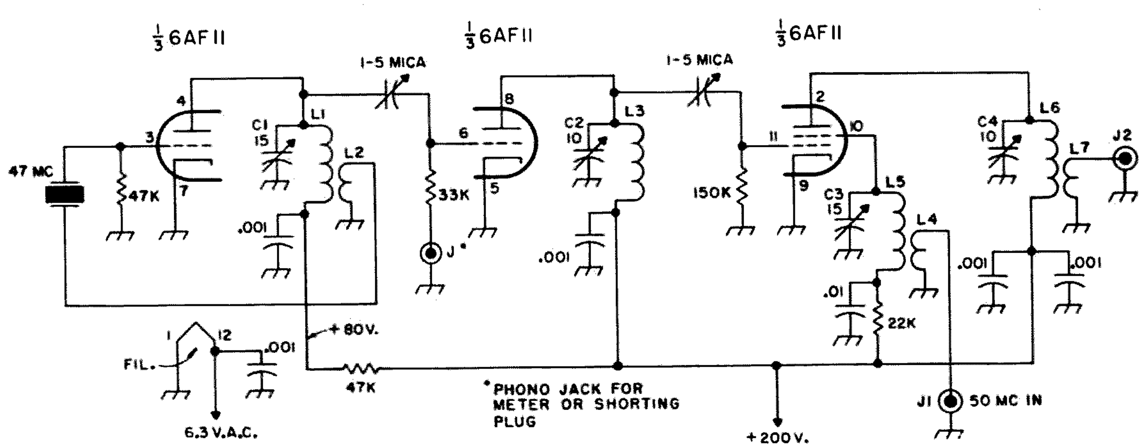


Fig. 2. Mixer portion of the two meter converter.

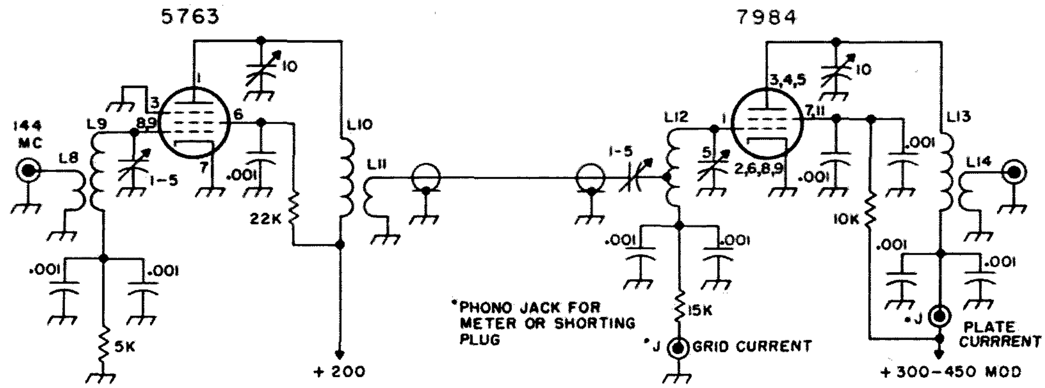


Fig. 3. Amplifier for two meters. Don't forget shielding and other good VHF layout.

But a little bit of looking turned up the General Electric 7984 Compactron designed for mobile and fixed communications transmitters. It is capable of delivering a power output of 46 watts at 175 mc! There is a slight hitch, though. It can remain slight depending on your attitude toward $5 tubes and how long you expect them to last. The rating is for *IMS*. That means Intermittant Mobile Service. That is an application where the design factors of light weight, minimum size and "exceedingly high power output" are the primary requirements even though the average life expectancy of the tube may be reduced.

Please note that I am not recommending 46 watts out all the time—unless you want to buy a new tube every so often. I *have* lit a 60 watt bulb to full brilliance on two, but normally run it on the air at a modest 60 or 70 watts input. It really lights a 25 watt bulb, giving about 30 to 35 watts out.

The manufacturer also published ICAS ratings. They suggest a 56 watt maximum input. So take your choice. The whole idea of a variable tube life based on power input is very interesting.

So much for input. The 7984 has the 12 pin Compactron base. Comparing it to the 6146, the lack of a phenolic base on the 7984 allows half inch shorter leads. The larger diameter also means greater spacing when needed and more connections per element. In **Fig. 3** you can see the many connections to each one. It makes a big difference on two. The spacing between grid and plate pins is enough to permit high power without any need for neutralization at all. Incidentally, the tube has a 12 to 14 volt filament.

The amplifier circuit

Fig. 3 shows the amplifier circuitry. Note that the first stage is a 5763 buffer. The reason for this was explained before. This stage runs very cool, but makes it possible to have a real stable signal. The extra tuned circuits help keep down the TVI, too.

The final stage is the 7984 power amplifier. Even though this tube, like more high gain beam power tubes, has a very high input capacitance, I was able to use a parallel tuned tank and still get excellent efficiency. Drive is about two or three mils through the 15 k grid resistor. Input to the 7984 is about 150 to 175 ma at 450 volts. I'd advise you to use a lower voltage for tuning up.

The modulator uses two 6L6GC's and was described with the six meter rig.

On the air tests

With a dummy load, tuned diode detector, transistor audio amplifier and well padded earphones, I listened to the modulation. It sounded good, so I put it on the air. This was my first experience with a two meter variable frequency transmitter. It's quite different from being crystal controlled. Even though two meters isn't a "listen only on or near your own frequency" band, it was fun to move around. I will also admit to more and more thoughts of six and two meter SSB and to the fact that this mixer can easily be adapted to sideband. Who knows what the future will bring?

. . . K1CLL

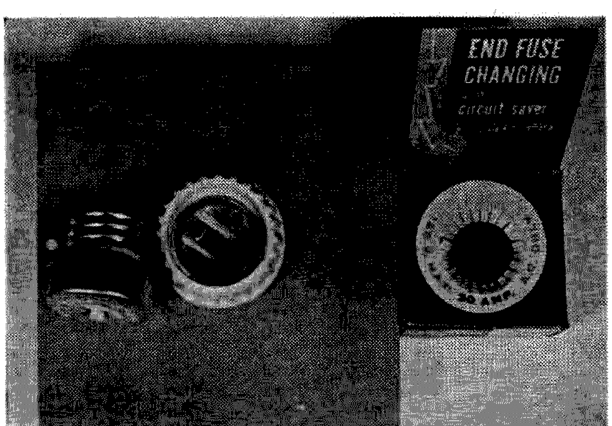
COIL TABLE

L1: 7 turns, 16 tpi, ½ in. dia.
L2: 5 turns #22, ins. inside L1
L3: 4 turns, 8 tpi, ½ in. dia.
L4: 2 turn link in L5
L5: 7 turns, 16 tpi, ½ in. dia.
L6: 2 turns #12, ¾ in. OD, ½ in. long
L7: 2 turn link near cold end L6
L8: 2 turn link over L9
L9: 2 turns ¼ in. copper strap, 7/16 wide, 1 in. long
L10: 3 turns copper strap similar to L9
L11: 2 turn link over L10
L12: 2½ turns copper strap
L13: 2½ turns copper strap
L14: 2 turnli nk

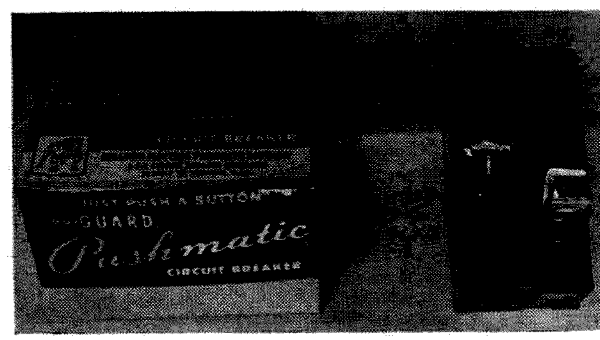
Roy Pafenberg W4WKM

Why Use Fuses?

Many existing amateur transmitters use the common plug fuse to protect heavy load circuits. While these fuses do an excellent job of circuit protection, there is always the problem of replacement. In transmitters prone to blow fuses as a result of minor maladjustment or other recurring conditions, fuse replacement is both costly and troublesome. While it is easy to install a higher current fuse, this is a dangerous business. Increasing the rating of the fuse above the manufacturer's recommendation may result in the loss of protection against other types of equipment failure.



One answer to the fuse replacement problem is a circuit breaker that screws directly into an existing fuse socket. The photograph shows one of these widely available thermal-trip units. The circuit breaker shown is a Sears, Roebuck and Company "Circuit Saver." These convenient little gadgets are available in 15, 20 and 30 ampere ratings and sell for a bit less than a dollar. These compact circuit breakers have a thermal element which opens the circuit in the event of overload. When tripped, the reset button located on the top of the assembly pops out, exposing the red shank of the button. To reset, you simply depress the button.



For new construction, consider the use of panel mounted circuit breakers instead of fuses. A wide variety of magnetic and thermal-magnetic circuit is available for power distribution applications. The other photographs show one of the available types mounted on a panel. This particular unit is a Bulldog "Pushmatic" circuit breaker. You simply push the exposed button to close the breaker and push it again to open the circuit or to reset after an overload.

These distribution panel circuit breakers are made by several manufacturers and are widely available in various ratings with 15 and 20 ampere units being the most popular. Cost varies with manufacture but averages a little over two dollars for the single pole units. When you select one of these circuit breakers, consider the mounting facilities which vary with manufacture. Many of these units have specialized mounting arrangements to suit available power distribution circuit breaker panels. Select a type that is readily adaptable to panel mounting. The "Pushmatic" unit shown required drilling and tapping of four mounting holes in the breaker front plate.

Go modern. Circuit protection provided by circuit breakers is, for many applications, superior to that provided by fuses, and from a standpoint of operating convenience and safety, the circuit breaker is far superior.

. . . W4WKM

Writing for 73

Perhaps you've noticed that for some obscure reason all of the top writers in the ham radio field seem to be writing for 73. This isn't just chance, by a long shot. These fellows know what they are doing. Let me unobscure the situation for you.

You've just built up something that you're proud of and the local hams are bugging you to write it up. Well, this turns out to be a lot of work you find, as you try to get one of the chaps who pushed you into helping with the pictures that seem to come out an indistinguishable blur with your Instamatic or old Polaroid. You thumb through the magazines to find out how to write such common items as rf, ac, CW, etc. Funny you never noticed that different magazines have different ways of printing these abbreviations.

Perhaps you've taken the time to write to me for instructions on preparing articles for 73. In this case you will already know that I prefer to have articles typed double spaced (which leaves me room for corrections) on 8½ x 11 paper with generous margins. Four of these pages is about equal to one in 73, in case you want to make a rough estimate of the length of your article. Articles should be two or three pages long for best readership, including the pictures and diagrams. The better the pictures the better the article. We have all diagrams drafted so all we need is a good pencil drawing . . . but *please* check and recheck it for accuracy. Put all parts values on the schematic rather than a long parts list. The R2 stuff is OK for discussing the operation of the circuit, but it raises the devil when you are trying to build.

Now, you've got the article written, the photos taken and the diagram checked. You maybe even have a parts layout. Where do you send the article? How about QST? Well you're up against some problems with them. First of all they do not pay one cent for articles . . . you are doing it for the good of amateur radio (and helping them earn over a million dollars a year). Secondly, quite a few fellows get a bit upset over their articles being rewritten and severely edited. Then there is the prestige of being published in QST to consider. More fellows will see it than in the other magazines, no question about that. Since they only publish one half to one third the number of articles that 73 does each month and a goodly portion of those are written by the QST staff, only a very few outside articles are ever published. Thus, if you are one of the chosen few you can well be proud. This pride tends to wear off after one or two articles when the $50 to $100 lost on the deal begins to come to mind more and more frequently.

Well, how about CQ . . . they pay for articles? One of the big bones of contention that I had with CQ when I worked there was the raw deal that authors got. They frequently had to wait from one to three years after submitting articles before being paid. I found that this dried up all of the worthwhile authors and left me with first-timers only. I note from an article in the January issue of CQ that they seem to be in the same predicament still. Also, some of our 73 contributors have written complaining about not being paid by CQ.

Is 73 any better? When I started 73 I made it a firm policy that all articles would be paid for on acceptance. I wanted to be sure and get the best articles submitted to 73 and, recalling the furious authors I had to contend with at CQ, despite my every strategem to

get them paid, I felt that the best way to do this was to pay off with the highest price the fastest. The system worked. Few articles take more than a month to be read and either returned or paid for. Now and then I get further behind or I am on tenterhooks about some article and I let it come to the top a few times before making a final decision. I pay from $15 to $25 per 73 page, depending upon the importance of the article, the weather, how good the pictures are, and other vague factors. With but one or two small exceptions where I goofed all articles that have appeared in 73 have been paid for considerably before publication.

It is only fair to explain that I am up to here in articles right now, having almost a full years worth on hand in various stages of preparation for publication. This means that I am being particularly selective these days. Before you plunge into the preparation of an article you should consider the yard stick I use in making my decisions. The first test is whether the article will be of interest to the great bulk of our readers. A modification of the Superbandbanger III for a product detector is not a thriller. Modifications of only the most popular equipments are of interest. Almost any construction article will be of interest if it is ham gear. Simplified technical articles, DXpeditions, transistorized equipment, are all looked on with great favor. Humor is usually not too funny, unfortunately, and should be submitted to QST, which seems to have the current corner on the market for unfunny humor. Modifications of equipment will do best with CQ. They will probably accept your humorous article if QST rejects it. Poems? not unless they are exceptionally good. I know poetry pretty well and will not accept anything but the best. Crosswords? Only if they are professional in construction. Cartoons? Yes, if they are really funny. We've done pretty well by you cartoonwise and I intend to keep it up.

Once you've been paid for your article you can expect to get some galley proofs of it in a few weeks or months. Next you'll get page proofs for final checking. These are for correcting typographical errors, not for last minute thoughts or changes, unless you want to send along a check to cover the unbelievably high costs of such nonsense. Get the article right the first time . . . then we'll both work to keep it right.

And if your article does get rejected take heart, about 50% of our rejects seem to turn up in the other magazines, so you still may get published. . . . W2NSD

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Catching Up With The Past—No. 2

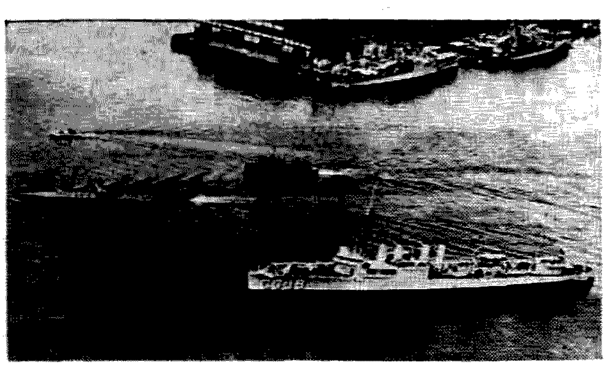
A Gold Award SOS

Today, DXpeditions sail, fly, and drive to remote areas of the Earth. All seek to open new countries or zones to the "gang". Great experiences surround these adventures: some thrilling; others, hazardous. None, however, brought more thrills to an Amateur than the expedition that left the United States thirty-two years ago for a voyage beneath the Arctic ice and under the North Pole.

Conqueror of the Arctic both afoot and by air, Sir Hubert Wilkins, the Australian explorer, headed a scientific expedition in 1931 especially equipped to study the polar sea from a submarine. The route picked extended from Spitzbergen, Norway, passing under the North Pole to the Bering Straits. By leaving Spitzbergen about July 1st, the Scientists hoped to reach a point near Alaska around mid-August before freezing started again. Their itinerary allowed 42 days for the 2100 mile trip.

The Expedition

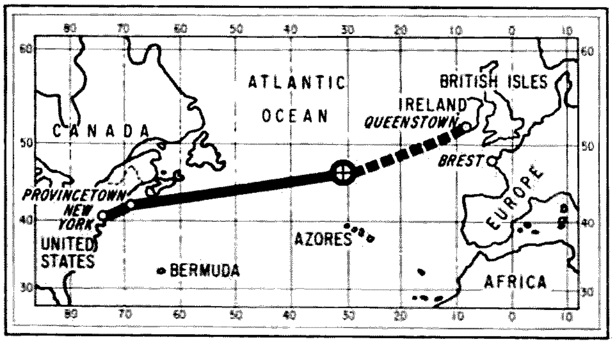
The Arctic had been crossed only twice before—by airplane and airship. Captain Sir Hubert Wilkins made one of these daring flights just three years before. In 1928, he and Ben Eielson flew an airplane across the unexplored Arctic from Point Barrow, Alaska, to Spitzbergen, Norway, covering the 2100-mile distance in 20½ hours. For that famous feat, Sir Hubert received a knighthood from King George the V. The flight still remained unequalled at the time of the Nautilus expedition.



The Nautilus sailing out of New York harbor under Naval escort for Provincetown, Massachusetts, and the start of the Polar journey.

Sir Hubert, a graduate electrical engineer, served as a Captain with the Australian forces in World War I. He included in his adventurous career: war correspondent, moving picture photographer, aviator, and polar explorer. The master of the Nautilus, Lt. Comdr. Sloan Danenhower, served many years in the United States submarine service, and inherited the lure of the polar regions from his father. (John W. Danenhower, also a submarine officer by profession, survived the tragic Jeannette expedition to the Arctic fifty years earlier.) Dr. H. U. Sverdrup of Norway sailed with the Expedition as Chief Scientist. He previously spent seven years in polar work, and accompanied Roald Amundsen as chief of scientific staff on the famous Maud expedition to the Arctic. Backing the Wilkins expedition were: American Geographical Society, Carnegie Institution of Washington, Cleveland Museum of Natural History, Det Geofysicke Institute of Norway, and the Woods Hole Oceanographic Institution.

The Scientists planned to conduct wireless telegraphy experiments in the Earth's flattened surface at the Pole, and experiment with voice transmission from the point on the flattened surface closest to the center of the Earth. While at the North Pole, they intended also to weigh the Earth and determine the geological content of the Earth's crust. And



The route followed by the Nautilus from Provincetown, Massachusetts. The cross marks the spot where W3AJZ sent the SOS. The dotted line charts the 1000 mile tow by the United States battleship, Wyoming, to a point near Queenstown, Ireland.

throughout the whole trip, they expected to study the animal and plant life, water currents, magnetic variation and intensity, and to note the formation and disintegration of the ice masses above and below the surface of the polar waters.

One of the major aims of the expedition sought to prove that submersibles could open up and bring development to the Hudson Bay district, and transport North American products to Europe cheaper by way of the Arctic. To prove the feasibility of such a scheme, they arranged to keep an accurate record of the influence of low temperature on the operation of the submarine, the batteries, and the engines. During the last half of the voyage, Sir Hubert intended to explore his pet project—long-range weather prediction—and determine the possibilities for setting up a weather station on the drifting ice somewhere between Alaska and the North Pole.

The Nautilus carried enough fuel to travel over 7000 miles on the surface. Plans, however, called for the "floating laboratory" to spend most of the time moving at 3 knots under the sea. At this speed the submarine could operate 40 hours and travel 125 miles on one charge of the batteries. Nevertheless, the explorers planned to limit travel to only 50 miles a day. By staying submerged 16 hours and surfacing in the leads of open water for eight to charge the batteries, the Scientists allowed themselves plenty of time for scientific investigation as they criss-crossed about the Arctic under the ice. Based on Sir Hubert's knowledge of the Arctic, they expected to find the ribbons of open water spaced about twenty-five miles apart. If in doubt at any time about the location of the next lead, they could push a helium-filled balloon out the conning tower to explore. The balloon carried a camera and a compass. Each picture taken included a view of the compass too. With every photograph referencing the direction, the explorers could easily determine the best way to proceed.

A six-months supply of ordinary ship's rations and a year's supply of emergency rations stocked the submarine's larder. If necessary, hunting in local waters with the rifles and shotguns carried along could augment those provisions considerably. Such extra foresight reflected the planning behind the whole expedition.

The Submarine

Renamed Nautilus in honor of the submersible in Jules Verne's novel, "Twenty Leagues Under the Sea", the converted U.S. World War I submarine left Provincetown, Mass., June 4th manned by an American crew. All possessed years of submarine duty. However, little about the converted Nautilus reflected the fighting submersibles on which they trained. She looked different both inside and out. Surfaced, she resembled a fat cigar floating in the water half submerged.

Ray Meyers, the radio operator, stood watch at the radio gear installed in the converted torpedo room behind plugged torpedo tubes. Ray's radio activities dated from 1910. Formerly 2MI and at the time of the Nautilus voyage, W3AJZ, Ray worked as a commercial operator from 1910 until 1912; served in the Navy as Electrician, Electrician-radio, and Radioman from 1914 'til 1930; and held the Chief Engineer post at broadcast station WDEL in Wilmington, Delaware, from 1930 until 1931. Recommended very highly to the recruiters for the Trans-Arctic Submarine Expedition, he signed on the Nautilus for the polar trip.

The Navy's 0-12 submarine—built in 1918 by the Lake Torpedo Boat Company in Bridgeport, Connecticut, and costing over $1,000,000—lay rusting in the back channel at the Philadelphia Navy Yard slated for scrapping under the London Naval Treaty. When approached about the Arctic expedition, the Secretary of the Navy turned the sub over to the U.S. Shipping Board who chartered her for five years at a dollar a year to Lake and Danenhower, Inc., of Bridgeport, Connecticut. This firm redesigned the undersea craft for the Arctic expedition.

The charter restricted the submarine for use in scientific research and required eventual scrapping in accordance with the disarmament pact. Lake and Danenhower, Inc., signed the charter then subcharted the 0-12 to the Trans-Arctic Submarine Expedition, Inc., headed by Captain Sir Hubert Wilkins. With his desire for a submarine now fulfilled,

Sir Hubert gathered together a group of scientists for the voyage across the top of the World.

The radio shack shared the converted torpedo room with a diving compartment, an airlock for holding sea water out while divers left or reentered the submarine, and the scientific laboratory. Underneath lay the Diesel fuel-oil tanks, and the lead-lined tanks containing distilled water for the Exide batteries. Beyond midship and just aft of the galley, two 500 BHP Busch-Sulzer-Diesel engines powered the twin-screw Nautilus and turned two 200 HP Diehl electric motors in the next compartment. When the sub operated on the surface, the electric motors became generators and charged two 60 cell banks of batteries. Each cell weighed 1000 pounds. Under submerged conditions, battery-power turned the motors and propelled the submarine. Half the batteries lay below the living quarters in the compartment behind the converted torpedo room. The other 60 cell group filled the compartment under the galley. Between the living quarters and the galley nestled the central control compartment filled with a maze of valves, gauges, wheels and recording instruments.

Besides driving the submarine during underwater maneuvers, the 5000-ampere/hour storage batteries energized a 440-volt motor generator set to supply ac filament and dc plate power to the transmitting equipment, and supplied the submarine's electric-equipped galley and other services. The Nautilus carried two radio transmitters. For the main work, an RCA 500 watt band-changing set with 849's in the final operated either CW or AM from 450 kc to 18 mc. The other, a 50-watt Radiomarine life-boat rig, served as an auxillary on 600 meters. Messages to the Nautilus came in over a Navy 1420C receiver. Except during the periods set aside for hamming, the submarine communicated under the commercial call WSEA.

Special Safety Devices

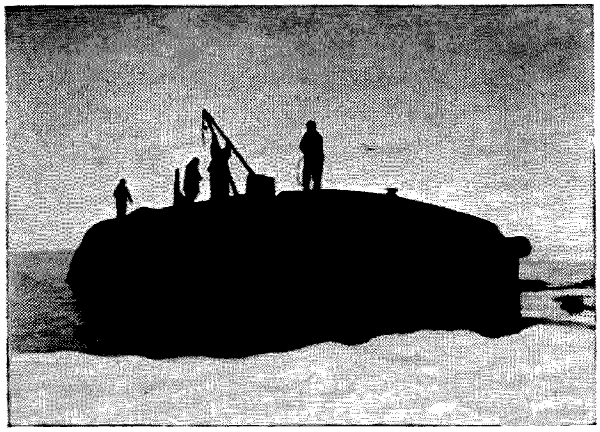
Thirty-eight new devices equipped the Nautilus for the journey under the polar ice cap. A number of them appeared topside. However, an outrigged superstructure enclosing the main deck, hid them from view until they performed their functions. When used, they emerged into view through the long narrow opening left in the top. Only WSEA's long-wire antenna showed regularly above the superstructure, and even that disappeared whenever the submarine dived.

A standard periscope couldn't survive among the ice floes so the Nautilus carried an especially designed one. Instead of sliding up and down in the normal manner, this one worked like a jackknife. When struck by ice or other objects, it bent over and voided damage. Collapsed, the periscope disappeared from sight between the sled runners.

The special superstructure enabled the Nautilus to go "sledding under the ice". It looked like a huge sled mounted up-side-down with the sides enclosed. Two broad runners extended the length of the 175-foot hull. Sloping upward a short distance from the bow and stern, they leveled off at a height that cleared the conning towers. By operating the submarine beneath the ice floes with a slight positive buoyancy, the sled runners pressed against the jagged underside raising and lowering the submarine on even keel, as they followed the rough bottom surface. This technique enabled the Nautilus to slide along under the ice like a fly walking on a ceiling.

Several of the devices mounted on the deck concerned the safety of the crew should the Nautilus get stuck under the ice. The unique conning tower combined a telescopic feature with an escape hatch. Containing an ice drill in the top and pushed aloft by two hydraulic pistons, this 28-inch-diameter conning tower could extend through thirteen feet of ice at the rate of one foot per minute. An electric motor revolved the head at 6 rpm and the ice cutter at 600. Set eccentric to the center of the tower, the cutter bored a hole through the ice slightly larger than the diameter of the conning tower. The 13-foot limitation satisfied the experts' opinion that the Arctic ice wouldn't measure over ten feet thick during the summer months.

No one of course knew the exact thickness of the Arctic ice. The Scientists, therefore, intended to measure it constantly as the submarine bumped along underneath the ice pack. A pneumatically controlled trolley arm fastened to a hinge in the top of the superstructure, moved up and down as it followed the ice pattern overhead. By comparing the reading of the indicator with the submarine's depth gauges, the Scientists could determine the thickness of the ice overhead. As a precaution in case the submarine encountered thicker ice than expected and became stuck under it with run-down batteries, two tubes with drills protruded from the deck above the motor compartment and the control room. By adding extensions, those drills could bore through 120 feet of ice to let Diesel-engine exhaust escape and fresh air for the engines and crew enter. This feature enabled the Diesel engines to run even though the submarine lay under water,



Five hundred miles from the North Pole, the silhouetted Nautilus prepares to dive under the ice floes in the Arctic Ocean.

and recharge the batteries for another lap of the voyage.

Another safety feature built into the Nautilus protected the submarine from head-on collisions with solid ice when running below the surface. It consisted of a collapsible bossprit. Sticking out ahead of the submarine twelve feet, this ram acted like a bumper and absorbed all shocks within its penumatic piston. The bowsprit also doubled as a lamp post for a special 5000-watt Westinghouse underwater lamp.

But these special safety devices only operated during specific situations. Over most of the voyage, the ultimate safety of the Nautilus and her crew depended upon the communication equipment and the radio operator. Two antennas connected the Nautilus with the outside world. One, a fixed loop, lay hidden below the superstructure. It rose through the deck above the radio shack, ran forward to the bow, aft under the superstructure, then back along the hull to the radio room. The second antenna, a long-wire, extended above the superstructure supported between two "V" shaped masts. This antenna worked only when the submarine sailed on the surface. During underwater operation, the "V" masts lowered to the deck inside the shelter of the enclosure. Over these two antennas W3AJZ handled the Nautilus' communications and worked hams in his spare time.

The Voyage

Pushed by her twin screws encased in ice guards, the Nautilus plowed steadily into the Atlantic at 10 knots an hour. In the distance, at the end of her ake, the coastline of Cape Cod gradually melted into the sea. Apparently the complete overhaul at the Brooklyn Navy Yard did the job. The engines beat evenly now. No hint existed of the trouble experienced on March 14th after taking on fuel at Marcus Hook, Pennsylvania. Engine failure at that time resulted in the ignominious tow by the nose through the Delaware Bay and along New Jersey's shore line to the Brooklyn Navy Yard.

Besides doing an unexpected overhaul of the engines, the Brooklyn Navy Yard also installed some special equipment. This gear supplemented the diving compartment and airlock built by the Philadelphia Navy Yard into the former torpedo room, and the "inverted-sled" superstructure and ice drills installed at the Mathis shipyard in Camden, New Jersey. Failure of the Philadelphia Navy Yard to finish the original reconditioning and modification work by December, upset the Nautilus' sailing date badly. Now, instead of the shore line of Norway fading in the distance, the coast of the United States still showed vaguely on the horizon.

Underway at last, the crew pondered what lay ahead. Success, or disaster. The chiding remarks of scoffers continued to ring in their ears. "The men will freeze to death." "You'll run into an iceberg and knock a hole in the vessel." "It will be dark under the ice and you'll lose your way." "The ice is hundreds of feet thick and too deep for the submarine to go down."

For slightly over a week the Nautilus knifed the mild seas splashing occasional sprays of salt mist into the superstructure. Captain Danenhower's course held the Nautilus in the Atlantic shipping lanes pointed for Land's End, England. Once in European waters, a new course would veer the submarine around the British Isles to Norwegian ports and ultimately into the Arctic Sea.

During this Elysian period, W3AJZ cleared traffic with coast stations KUP and WRH until 9 PM EST then opened up on the ham bands. Under the calls K7XI and W3AJZ/mm, Ray kept regular schedules with W3QV and worked many of the other hams. He picked the frequency most suitable for prevailing conditions and designated the Amateur band for the replies. The 3.5 mc Hams listened on either 5555 or 6620 kc; the 40 meter "gang" tuned to 8450 or 11110; and, on the nights the 20-meter band stayed alive, 14 mc Amateurs found his signals on 16660.

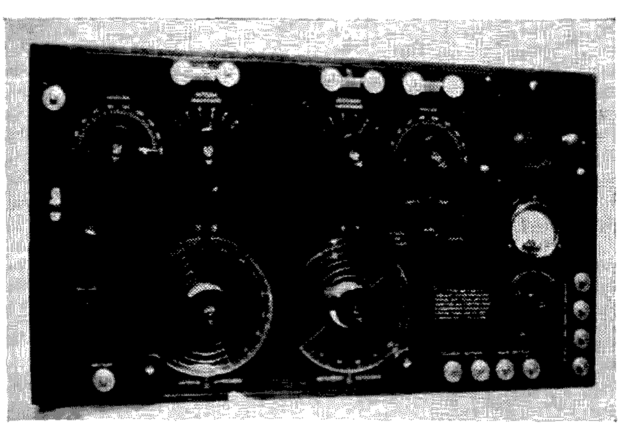
W3AJZ enjoyed a "ball" until the Nautilus reached mid-Atlantic. There all fun suddenly ceased. The starboard Diesel cracked a cylinder knocking that engine out and taking half the submarine's battery-charging facilities with it. As the remaining motor couldn't overcome the discharge rate, the batteries grew steadily weaker.

Loss of one engine only slowed the Nautilus two knots. With the port Diesel and a half wake, she still parted the sea at 8 knots. But the generator loss really hurt. Captain Danenhower and his officers sized up the situation. If the weather held good, they believed they could reach their destination without any help. They decided to try. Meanwhile, Captain Danenhower wirelessed home ordering the necessary repair parts sent on ahead.

But the weather didn't hold good. The wind began to blow. It grew from moderate, to fresh, to *strong*. Soon the choppy sea tipped with whitecaps spread into long, deep swells. And the growing billows, urged on by the relentless wind, rose higher and higher. As the waves increased, the submarine's battery power decreased. In a short while, radio communication with the Nautilus became mostly a one-way affair.

When one fuel tank ran dry, they switched to another. Soon the lone engine started to knock. While the engineers searched for the trouble, someone made a terrifying discovery: As the fuel level went down, so did the submarine. The Nautilus was slowly sinking!!

Investigation showed sea water mixing with the fuel. But how did it get in? An engineer with a hacksaw shortened the standpipe in the tank so it didn't penetrate beyond the pure oil near the top. The engine responded immediately. Then a member of the "black-gang" discovered waste clogging the vent pipe and removed it. Meanwhile, a study of the submarine's construction revealed the Kingston valve used for diving purposes located in this fuel tank. When they tried to close it, the control wheel spun. Broken! Now they understood the trouble: As the engine sucked fuel, the heavier sea water seeped in to replace it.



A Navy model 1420C receiver. The radio operator threw one of these into oscillation and keyed the antenna circuit to send the SOS. Courtesy of the W2ZI Historical Wireless Museum, Trenton, N. J.

The more fuel used, the heavier the submarine got. Responding to the constant increase in weight, the submarine gradually settled towards zero buoyancy—the point of sinking.

By now the storm raged fiercely. Forced to reduce speed, the single-hulled Nautilus—true to her "pig-boat" type—wallowed in the waves with superstructure often awash. Indicators on the inclinometers rolled from 47 degrees to port to 47 degrees starboard. Oil seeking its level sloshed annoyingly from side to side. Suddenly, a huge gray shadow bearing down straight ahead became the White Star liner, Homeric. She missed the Nautilus by just a few feet. And as the severe rolling sapped the sea legs of many in the crew, the motor behind the good Diesel burned up in a series of sparks sealing the doom of the already weak batteries. Captain Danenhower ordered an SOS.

Fortunately the Captain's course from Cape Cod held the Nautilus in the Atlantic shipping lanes. Aid would arrive quickly once the call for help went out. With the Nautilus' position on a slip of paper before him, W3AJZ reached for the power switch. Maybe the submarine's batteries would turn the motor generator long enough for one call. He threw the switch and listened for the high-pitched whine. *It didn't come through*. Only the scream of the sea reached his ears as the Nautilus tossed and rolled 1700 miles east of Cape Cod, surrounded by help but without the means to summon it.

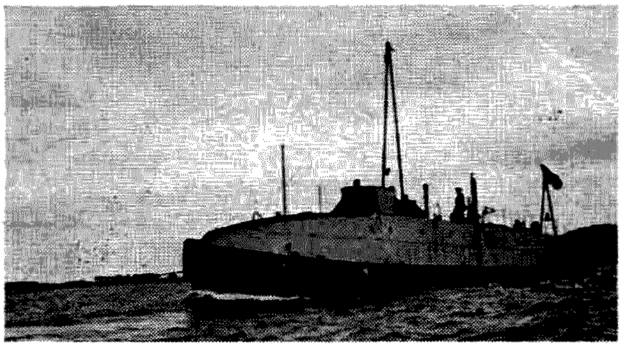
But the receiver still worked. In desperation W3AJZ turned to his Navy 1420C. If you're an Old-timer, you'll remember the old trick taught to students by wireless schools as late as the early "thirties": Set the regenerative receiver for CW and key the antenna lead-in. Ray tuned the set to 600 meters and sent it into oscillation. A feeble signal radiated back to the antenna. Bracing himself agains the heavy roll of the sub, he tapped out WSEA's first SOS.

In a few moments he stopped and listened, heard nothing, and called again . . . then again . . . and again. An hour passed—two hours—three! *Nothing*. Less than a watt on 600 meters going into an antenna scraping the wave-tops, offered scant competition to the strong signals usually heard on the combination calling and distress wave. Twelve hours later: still no change—only a crew sore from bumping about in the close quarters of the wallowing submarine, and a wireless operator weary and cramped. An endless supply of hot coffee kept W3AJZ alert as he doggedly continued tapping and listening in the restricted confines of the radio room. *Eighteen hours*

after the first SOS left the "receiver", call letters W-S-E-A blasted from the earphones. An answer at last! Somehow the radio operator aboard the SS Independence Hall snared the whisper-of-a-signal from the loud QRN and now asked the Nautilus' trouble and position. "Mechanical. Latitude 46.40, longitude 30.30," flashed the overjoyed reply.

Before long, the SS Independence Hall's superstructure appeared above the waves as the freighter moved in close and stood by. Shortly after, the United States battleships Arkansas and Wyoming hove into view. Following a few wirelesses to naval authorities in Washington, the USS Arkansas continued on the Midshipmen's Cruise to Europe while the USS Wyoming interrupted hers to tow the Nautilus to Ireland.

Getting a line aboard the Nautilus proved difficult. The USS Wyoming maneuvered several hours in the high seas before the line drifted along side the stricken submarine. Even then, rough seas and lack of winch-power prevented the submarine's crew from pulling the water-soaked hawser aboard. In the process of trying, a giant wave swept Frank Crilley, the main diver, overboard then washed him right back again. Hours later, when the sea moderated, the crew succeeded in fastening the rope to the Nautilus' bow and she started the 1000-mile tow. Near Ireland, the USS Wyoming cut loose and an Irish tug continued the tow into Queenstown. As the Nautilus neared the wharf, a welcome rang out from shore: The bells in St. Coleman's Cathedral pealed the Star Spangled Banner.


The Nautilus under tow by an Irish tug as she nears Queenstown, Ireland. A World Wide Photo.

Conclusion

Completely repaired at Devonport—the British navy station near Plymouth, England—the Nautilus continued on her way to Norwegian ports and W3AJZ resumed hamming activities. The Nautilus left Spitzbergen, Norway, August 19th and entered the pearly gates of the Arctic. Lumps of rough ice the size of summer cottages loomed out of the fog to greet her. Picking a big floe, Captain Danenhower prepared to send the submarine under. Then came Sir Hubert's most crushing disappointment: Somewhere among the ice floes the Nautilus lost both diving rudders; without the "elephant ears", she couldn't dive.

Nevertheless, during the ten days spent in the Arctic Sea, the explorers demonstrated the soundness of the "sled-runner" idea many times by tilting the bow down with ballast and pushing under the floes. Each time they marveled at the sight visible fifty feet around them. Varying light, caused by the passing clouds overhead, "painted" the scene continually with changing colors creating an effect like the "painted desert" in north-central Arizona. One of the floes they sledded under measured 17 feet thick. But, as expected, the explorers found no icebergs; icebergs mostly come from glaciers on the Greenland coast.

During the short stay in Arctic waters, fresh water pipes froze solid; the periscope fogged and got stuck; the ice drills jammed; a battery cell, unable to stand the rapid temperature rise from almost freezing to considerable heat during rapid recharging, cracked and spread acidy gas fumes throughout the submarine; heavy precipitation forming on the inside of the single-hull Nautilus, froze on the floor of the living quarters; and a rivet started to give in the diving compartment letting icy water seep slowly through.

Recognizing the lateness of the season and the fact that to do their work thoroughly and in safety, they required a newly-equipped double-hull ship, Sir Hubert regretfully turned the Nautilus back to Norway and discharged the crew. On March 20th, complying with the terms of the London Naval Treaty, United States authorities sank the Nautilus in the 200-fathom water of the Bergen fiord. Sir Hubert never realized his dream of sailing under the North Pole, but he lived to see his dream come true. The Navy's atomic-powered Nautilus II sailed across the North Pole under the Arctic ice on August 3, 1958. Sir Hubert died the the following December.

Ray Meyers, the wireless operator on the Wilkins polar expedition, received a gold medal from the Veteran Wireless Operators of America for his outstanding work in radio that year. Today, Ray is ARRL Director for the Southwestern Division. If you would like to swap adventures, work him when you get a chance. You'll find him on the air under his 6-land call, W6MLZ.

. . . W2AAA

Gus Browning W4BPD

Gus. Part V

Last month at the end of that chapter of "Gus Rides Again," I was on the train right in the middle of East Germany on my way to Berlin with "Polizei" all over the train, and of course at every stop along the way. I kept wondering if they were out because there was an American on their train. They all seemed to be looking at me. It does make a fellow have a funny feeling, but after a while I got used to all the police and security officers everywhere and I just did not pay them any more attention. I began looking around the railway carriage I was in and noticing how everyone was very quiet, no smiles. It was rather a gloomy lot.

At lunchtime, I noticed that almost everyone had their own food with them. A fairly well-dressed man sitting beside me saw that I had nothing to eat and offered me some of his sandwiches of black bread and sausage. I found that this man could speak fairly good English. He asked me where I was from and I told him. He was amazed to find that Americans could come and go from the US anytime that they wanted to. He was even more interested in the fact that we could take as much money out of the US as we wanted to. He asked me if I had checked into the US Consulate in Hamburg and told them where I was going. I told him I had not even thought about that. He was more flabbergasted. His picture of life in the US was pretty distorted. At this time, the train was passing through a big wheat field and I noticed that there were many workers in the field gathering wheat, and that they were using old-fashioned sickles to cut the wheat. They all were women, in groups of ten, equally spaced across the field. I asked him why they were spaced like that. He said that was to be sure each one did her task and did not loaf. I asked him how long he thought it would take them to gather all the wheat in that big field. He said he would guess about 7 to 10 days. Then he asked me how they would gather wheat like that in the US. I replied that they would use a reap-and-binder. He asked how many people would work in such a field with this reap-and-binder. I told him probably two or three. Then he asked how long it would take to gather that much wheat . . . I answered probably one day. That really stopped him for a while. He just sat there thinking. Eventually he asked me about all that unemployment we have in the US, mentioning that they had none in the German Democratic Republic. He then went further and said that he could see why there was so much unemployment when we had such things as those reap-and-binders that took the place of about 50 people. He said everyone worked there, even the women, like those we saw in the wheatfield. That's when I said, "You use

your system and let us use ours. We like for our ladies to be rested when we come home to them, not tired and sweaty from gathering wheat all day." Well, that really quieted him.

The train continued on, and let me tell you, it was a very rough trip. The train was jammed . . . even the aisles were full. The ride was so rough that suitcases fell on people from the overhead racks. The train made its last stop just before entering West Berlin, and most of the passengers got off. Everyone had to show their passports or identification passes again. Then all the German Democratic Republic officials got off the train and the West Berlin officials and train crew got on. Our passports were glanced at again and the train was off. In a few minutes we stopped. We were in West Berlin . . . and I was glad that the trip was over!

I had a QSO with Wolfe DM2XLO while I was at DL6ZZ and he knew when my train was to arrive in West Berlin. We had arranged a get-together at the Zoo station of the subway. Our identification was a QSL card he was to have on his hat band. He was there waiting. Wolfe was a very nice chap and spoke very good English. We boarded the subway and away we were to East Berlin.

In those days there was no Berlin Wall and people in East Berlin could come and go without much trouble. Wolfe lived in the section of East Berlin called Koepenick, in a nice clean house. Wolfe is manager of an electronic factory there. I found that he had done lots of traveling all over the world, even in Red China.

I also spent a few nights with DM2FSO and his beautiful platinum blonde wife. He had a car and drove me all around East Berlin where we met lots of the radio amateurs there. They all treated me very nice.

In East Berlin I saw many buildings still standing just like they were on VE Day; no attempt was made to rebuild them at all. The opposite was true in West Berlin. There is a difference between East and West Berlin! The average East Berliner is a dull, drab looking fellow, dressed in a plain suit, no smile, and a beat look on his face, walking slowly as if he just did not care any more.

The day for me to depart from East Berlin arrived and DM2FSO and his wife took me down to the railway station. When we entered the station, DM2FSO asked me to wait a few minutes in the waiting room. In a few minutes he came back and he handed me my ticket to Prague, Czechoslovakia. This was a real surprise to me, because I certainly did not expect him to buy my ticket. I tried to pay him for

the ticket and he would not think of letting me pay. I stood on the platform waiting for the train to depart, talking to him and his wife. They were not happy to see me leaving. His wife had tears in her eyes and they both expressed wishes for me to return and visit them again soon. It seemed as though I had known them for a long time. They were so sincere and friendly. Just as the train blew its little high pitched whistle to depart, he asked me if I had any East German Marks for my food. I answered no, and he handed me a bill, and the train departed for Prague. When it was time to eat, I gave the bill to the steward in the lunch car to pay for my food. He gave me back a whole handful of bills in change. Later on I found out that the bill I had been given was worth something like $20. Now what do you think of that? You just can't find that kind of friend very often.

The trip to Prague

This train was very similar and the tracks about the same as the ride through East Germany to Berlin. There were just as many police as before, and they all seemed to be looking at me most of the time. I was more or less getting used to being gazed at by then, so I just didn't pay any attention to them. Food on the train was OK, and it was cheap. As usual, the train was jammed full of people, many standing. I can certainly say that people over there really use the trains for their transportation. The cost of rail fares is very cheap too. I strongly suggest that anyone wanting to tour Europe use the railroads . . . you can save lots of money and you get to see the countries and meet people.

While in East Berlin, I had a number of QSO's with the fellows in Prague and they promised to meet me when I arrived there. At the border between East Germany and Czechoslovakia there was the usual customs check, money changed to Czech money, change of police on trains, etc., and you were in Czechoslovakia. You could see that the people were a bit better dressed and they seemed much happier than they were in DM land. I remember some of the QSL cards from OK stations saying that it was the country of "the happy people." I suppose someone like me must have taken a similar trip like I did, and same in OK land and then noticed the difference between DM land and OK land . . . so they had decided that OK land was the land of "happy people." Well, comparing it to DM land I suppose it is at that!

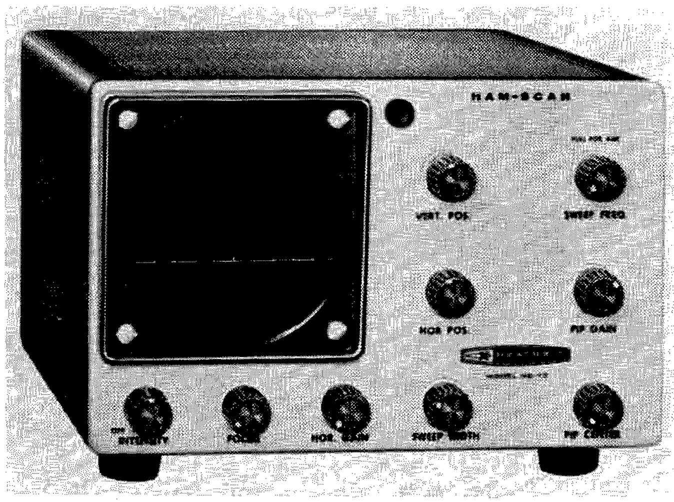
The train pulled in the station at Prague and I was really surprised at the number of OK hams that met me at the train. Many pictures were taken, a lot of hand shaking, and I could see that my stay in OK land was going to be very pleasant. While in Prague, I stayed with Myrek OK1FF, and every moment was most enjoyable. I have yet to find anyone more friendly than Myrek.

My stay in Prague was one continuous round of visiting hams. Every night it was at one of the fellow's homes or some very fancy restaurant. Those OK boys can drink more vodka than I can drink Coke! I drew a big laugh when these fellows gave me a tall glass full of Vodka, when I poured some of it in a saucer and struck a match to it and the flame was a beautiful blue . . . and I said, "None of that flamethrower stuff for me!" There were no Cokes in any of the "curtain" countries . . . and the coffee was so strong that I had to chew it.

While in Prague I asked about the whereabouts of Beda OK1MD. The answers were always the same: no one seemed to know his whereabouts. In fact, they just did not want even to talk about him at all. One day one of the local fellows and I were walking down the street together, no one was with us, so I asked him what the story was about OK1MD. He said something like this, "Beda did too much talking. He tried to run the activities of the DX boys around Prague." He said that the caravan that OK7HZ was with had very bad radio operators and that they should have been DX operators so that they would know how to work the world from their various stops. He then explained to me that this OK7HZ caravan that was going to many rare countries was basically non-ham radio minded, but ham radio was included in their caravan only for the purpose of communication back home. It was not a DXpedition at all as many people seemed to think. It appears that Beda just talked too much, and I guess when you are in OK land you should not do that

One night I met one of the publicity men of the big radio station there in Prague. He asked me to come down to the radio station the next morning to make a talk about my trip. I asked if they were going to tape my speech and re-edit it before airing it? He said that it was going to be a live broadcast. I asked what I should not mention over the mike. He told me to talk about anything I wanted to, but suggested that it would be a good idea not to mention anything about politics or religion. When we departed he said, "I'll see you at the radio studios tomorrow morning, comrade."

Watch out, Gus. You're going in the Lion's Den!



Charles Leedham WA2TDH

The Heath Ham Scan

There you are, sitting up late at night, idly eavesdropping on a local QSO on a very dead 20 meters, interested in a good local contact but not particularly wanting to break in on the one you're hearing. Suddenly you see a station come on the air 30kc higher on the band. You tune up to the spot and catch his call, give him a blast, and there you are. You *see* a station come on the air? Yep. You do with the new Heath HO-13 'Ham-Scan' Panoramic Adapter. Using this nifty little box of Benton Harbor tricks is like turning on the light in a dark room. It adds a whole new dimension to ham operating—you can now *see* what's happening on the band instead of fumbling around with the dial hoping to find something.

What the HO-13 does it take up to 100kc of the band and show it to you on the face of an oscilloscope tube. It gives a visible report of everything that's happening within that 100kc reading from the high segment on the left of the scope to the low on the right. The frequency you're turned to is always at the center of the scope, with the signal you're hearing popping up and down as a pip in the middle. Other signals on the band—50kc up and 50kc down—show themselves as little jumping pips above or below the center, or rather to the left or right. You can even tell whether they're CW, SSB, AM or RTTY.

Basically, the HO-13 is a second *if* system branching off from the mixer of your receiver. The signals from the mixer plate (which are amplified and eventually converted into sound by the *if* inside the receivor) are taken by the HO-13 and amplified, and than scanned by the frequency sweep of an internal oscillator. Starting 50kc down from the point the receiver is tuned to, the sweep goes along looking at everything in the *if* up to a point 50kc above center, and does this from 10 to 50 times per second, depending on where you set the Sweep Frequency control. About the best analogy at hand is a comparison to ordinary receiver tuning: you could do pretty much the same job as the HO-13 if you swung your receiver back and forth across a range of 100kc, and listened and remembered everything you heard. But you'd have to do it at least ten times a second—and the HO-13 takes the remembering out of it by displaying the information on the face of the cathode ray tube, with the signal pips showing you exactly how far away—higher or lower—all the signals are from the center point.

The kit is a simple one to build, representing 12 to 15 hours of work, all very straightforward and made easy by Heath's usual careful instructions and clear pictorials. In only one spot is there some small opportunity for confusion, and this is on pages 16 and 17 of the manual, where you are told to attach wires to control terminals and then route them through clamps for later connection. Heath supplies only one color of hook-up wire, and it would be worthwhile for you to use some of your own wire of different colors for these two or three connections. Either that or make your own code of knots, or stick on pieces of tape. Otherwise you may end up like me, with the horizontal and vertical controls reversed at first, because it isn't easy to follow those same-colored wires through when the time comes later for hooking up the far ends to the proper terminals on the back of the CRT.

Heath has very wisely designed the HO-13 to operate with a wide range of receiver *if*'s. Parts and alternate instructions are supplied for using the Scan with ten different *if*'s ranging from 455 to 3395kc. Again, the instructions are clear, but there is a small possibility of confusion here if you try to keep everything in your head. The instructions will say, for example, to install Resistor R203, but R203 can be any one of several different values depending on the *if* of your receiver. You have to go to a separate table to find out which, and it is a good idea to write down right in the instruction steps what value R203 (and the others) should be.

Once the kit is done, you have to get some signal for it from your receiver but, as a 73 reader, you are certainly not one of those who screams with fear at the thought of going inside the box with a soldering iron. The signal you want is taken from the mixer plate of your receiver. This requires fastening a capacitor (supplied) to the plate and running a small coax (supplied) from there to the back of the Ham-Scan. If you have a "Spare" jack or terminal on the back apron, you run the coax to that, and then make up a cable to go from there to the HO-13. If you have no such connection, then you'll have to make a tiny hole in the back apron of the receiver and run the cable straight from the mixer pin to the Scan. However, the RG-62U supplied is so small that the hole can be very, very tiny, and shouldn't harm the value of the receiver as a trade-in, particularly if you pull out the connection and coax before you take the machine down to your friendly ham dealer. Also, just in case you're not sure which pin of which tube is the mixer plate, Heath even goes so far as to supply a full-page table listing the proper tube and pin for 7 makes and 19 models of receivers, thus covering most of the receivers around.

If you're one of the many in the fraternity who have found the Ham-Scan's predecessor, the HO-10 Monitorscope, a valuable operat-available from Heath, part number 206-238 ing aid, you will be interested to know that the Scan provides a special mu-metal shield for the cone of the 3RP1 tube which completely eliminates any possibility of AC ripple in the CRT trace. This special shield, incidentally, is for $2.35, if you want to get another one to put on your HO-10. As soon as I built the HO-13 I wrote to Heath for another and was happy to find that it cut out 99% of the tiny HO-10 ripple that had been bugging me.

Turn on the receiver and the Ham-Scan, and as soon as the audio hits the speaker, there is the whole spectrum of the band in front of you. The sweep range of the HO-13 can be varied from about 30kc to 100kc. Thus you can monitor a wide part of the band, or you can cut down the range to widen the pip of a particular signal and take a closer look at it. It gives you an instant picture of the quality of whatever you're hearing, because it shows you exactly what's happening at every point in the spectrum—overmodulation, splatter and such. Also, if enough of your transmitter signal gets through to your receiver *if*, you can take a critical and continued look at your own signal.

You will at first be stunned by the amount of stuff that's going on in the *if* of your receiver—all the noises, pulses, garbage, and a few signals. Pretty soon you won't be able to believe that you ever operated without it. Looking for a signal on a quiet band? Just park your receiver at the middle of it—say at 14.3 on 20—and everything that moves will show up on the scope. Got a good contact who's being clobbered by QRM? No longer do you have to tune away—and with a transceiver, maybe forget where you were and never get back—to find a clear spot. Just let your eye wander along the trace and you'll immediately see by the lack of pips where you should QSY. And what with the calibration marks along the base line plus a little experience, you will be able to impress the bejabbers out of your contact by telling him instanter that you see a clear spot exactly 23 kc down.

The HO-13 costs $79 from Heath, which takes panoramic fun right out of the rich man's class and brings it down to all of us. It's well worth every cent of it.

. . . WA2TDH

Martin Smith W8ADV
27389 Cook Road
Olmsted Falls 38, Ohio

The Sub-Antenna

Guaranteed to bring in loud, clear DX right through summer static, regardless of weather. I doubt the winds will blow this one down!

It was a known fact that radio waves travel through the ground just as they do the air. Listen in to Mother Earth's clear "Constant Potential" ground waves. Even the primitive Indian knew the greater carrying power and absence of interference in sound waves transmitted through the ground. The same is true of radio. These are some of the ads back in "Radio News" September, 1928, that started the whole thing here.

I had a receiver, and a nice long ground that I've been using for over four years now. So as I began to think about it . . . Well let's see now. Take the antenna off the receiver, now take that ground off the transmitter, put it on the receiver that's pretty dead right now. "WOW", signals, sure hard to believe but here it is!

The ground described is a fifteen foot piece of heavy rubber coated wire, I would guess about #4. The ham shack is a 9 × 12 block building 100 feet back of the house. This heavy wire goes out through the side to a ground rod 5 feet long. To this is also tied a heavy aluminum clothesline which runs along the ground to a second 5 foot stake about 6 feet north of the ham shack. From here it goes to a 60 foot drilled well about 90 feet to the north of the shack. The wire is buried just under the grass and upon reaching the well it is connected to the well casing, ergo: water contact. Thus you have an underground antenna.

The following are various reports:

W8GNP—Loud and clear—about fifteen miles away

W8LHW—Jack said: "This is the loudest signal I've ever heard in Avon, Ohio." -40 DB over S9 he has never heard a station as close as Lorain, Ohio, which is much closer to him, come close to that S-meter reading.

W3ØX—Tony near Pittsburgh said he heard it very well.

W8QMB—Ravenna, Ohio

W8KJU—Jeromesville, Ohio

W8BIQ—Toledo, Ohio

WA8ADB—Cincinnati, Ohio

K8BBI—Cincinnati, Ohio

W4SBM—Ft. Thomas, Ky.

and many more in Michigan. his was on 1805 kc to 1820 kc.

I tried it on Ohio Mars 2258 kc and was heard over the state of Ohio. The next experiment was on 3830 kc on which two more stations were worked: K8SEY in Genoa, Ohio and K8PER in Newcomberstown, Ohio. The last frequency tried was another Mars frequency, 4030 kc, and again good coverage.

I'm sorry I can't say what the resonant frequency is; however, it does seem to be vertically polarized. Again I'm not sure of the feed point impedance; however, the Ranger II doesn't seem to change very much when switched to a full wave Diamond (520 ft. for 1.8 mc.). The top of the diamond is at 75 feet and the bottom feed point is 7 feet from the ground.

It should be noted that the diamond antenna was installed after the underground tests were run. There is a difference between the diamond and underground antenna in performance, the diamond being better; however, if a strong wind should come along and blow down the diamond, I still have the reliable underground antenna to support my activities.

I still haven't figured out what I've done, but I'm having a lot of fun with the gang around here. Needless to say, do I have the company looking for a larger coffffee pot.

. . . W8ADV

Robert A. Kidder
20 Prescott Street
Nashua, New Hampshire

Passivating Aluminum Alloys

It may come as a surprise to many people that much of the aluminum in use for a great variety of purposes requires surface passivation. This is a fancy way of saying that such items as aluminum chassis and front panels need some kind of protection against corrosion. The reason for this is that virtually all aluminum in common use is alloyed with other metals, mainly magnesium, and to lesser extents with copper, manganese, and silicon. It's true that chemically pure aluminum passivates itself by forming a film of aluminum oxide on its surface, and that the oxide film is impervious in general to further atmospheric attack. From a chemical standpoint, however, aluminum alloyed with other elements is highly impure, and its tendency to corrode is greatly multiplied. Apparently the other metals in the alloy have a catalytic effect on the aluminum, and in electronic equipment corrosion may be further aided by electrolysis.

Fig. 1
First Aid

Cardinal rule: Call the nearest hospital or doctor immediately.

Acid or caustic burns:
Rinse immediately with running water. Do not scrub, wipe, blot, or even touch the affected area. After rinsing for at least 10 minutes, cover the burn with a loosely fitting, clean, soft cloth. Do not apply salves, ointments, or other medication of any kind.

Acid or caustic in the eyes:
Rinse continuously with running water, keeping the eyelids open. Flush the surrounding areas also. Do not apply medication of any sort.

Swallowed acid:
Drink immediately one quart of milk (one pint for a child 5 years or younger) or one tablespoon of milk of magnesia in a cup of water. Do not try to induce vomiting.

Swallowed caustic soda:
Drink immediately one quart of milk, vinegar, or any fruit juice (one pint for a child 5 years or younger). Do not try to induce vomiting.

Swallowed solvents:
Drink immediately one quart of milk and induce vomiting by prodding the back of the tongue and the throat with the fingers or a spoon.

In all cases:
Once again, call the nearest hospital or doctor immediately.

Granted that surface protection of some sort is required for aluminum alloys, what alternatives are available? The easiest way out is paint. This is also the least satisfactory, when primer and paint by themselves are used. There are two more answers to the question, both of which are eminently satisfactory: alodizing, and anodizing. Both processes result in the formation of impervious films which are molecularly bonded to the surface of the alloy.

Alodizing is a purely chemical treatment which produces a very thin (about 3 microns deep), electrically conductive coating that's proof against normal atmospheric conditions, including industrial smog and sea air. The process described herein imparts a mustard color to the alloy, but the surface can be buffed with a clean, soft cloth to yield a finish that resembles polished bronze, or fogged gold plate. Unbuffed, it's an excellent base for primer and paint.

Anodizing is an electro-chemical treatment which produces on the surface of the alloy a heavy film of aluminum oxide that's electrically non-conductive. For those who may be interested, emery and ruby are also forms of aluminum oxide. It's second only to diamond in hardness, physically tough, and practically bomb-proof to corrosion. As formed by anodizing, it's satiny silver in appearance, but it's porous and can be colored by dyeing. Dyes are available in a bewildering array of colors and metal tones. Being non-conductive, anodizing is a dandy finish for transistor and diode heat sinks, because the devices can be bolted directly to the heat sink without using fiber washers or mica gaskets. This results in much more effective cooling of the semiconductors.

Both of these processes can be carried out at home if suitable equipment can be scrounged, jury-rigged, or (perish the thought!) purchased. Before diving into the details of either treatment, however, the author is conscience-bound to emphasize certain

essential safety measures. Both processes entail the use of dangerously corrosive chemicals, and specific precautions must be observed to insure both personal safety and the protection of various household appurtenances, notably the plumbing. It may seem that the writer is going to ridiculous extremes in making the following recommendations, but he has seen the results of caustic and acid burns. They are excruclatingly agonizing to experience, and they leave permanent, ugly scars. Even a tiny spatter of acid or caustic in the eyes can cause blindness. Needless to say, these chemicals are violently poisonous if swallowed. In spite of all that, they are not dangerous to work with *if they are treated with respect and handled with due regard for the potential havoc they can wreak.* The importance of strictly following the safety measures outlined below is impossible to overstate.

Familiarize yourself and several friends or family members with the First Aid information given in Figure 1. Have one of these people in the area at all times while you are working so that emergency treatment can be rendered instantly in the event of an accident. The one factor that literally will save somebody's hide is the speed in which First Aid can be initiated.

Ventilate your work area. A regular kitchen exhaust fan is adequate if you set up your equipment under it. An electric fan blowing out through a window will also do nicely. At the very least, open all the windows and outside doors of the room in which you are working.

Wear protective coverings. The minimum is a pair of *watertight* rubber gloves and goggles, or a swimmers' face mask. If you can turn up a rubber apron and a pair of rubber boots or galoshes, so much the better, because raw sulphuric acid will burn through a leather shoe or a trouser leg in very short order.

Leave a nearby water faucet running at all times while you are working with or around these chemicals. This spigot should have enough free space beneath it to allow getting the face under it in an emergency. Also, keep a pail of water in a handy location where it's not likely to get contaminated by any of the chemicals. This is for use in case acid or caustic is spilled on the torso or the legs.

Flush or wipe up spills immediately. Also rinse promptly anything that comes in contact with these chemicals, including gloves, stirring rods, and measuring containers. Upon completion of the work, rinse the gloves and other protective coverings before taking them off.

Fig. 2

List of Materials

Pickling (Cleaning) Process

Equipment:
- Steel, stainless steel, or plastic container
- Glass or plastic container
- Beam balance, or spring scale accurate to one gram
- Steel rod
- Glass rod
- Stove, or hot plate ...... optional
- Thermometer, reading to 212°F. optional

Chemicals:
- Nitric acid (HNO_3) 42% concentration
- Caustic soda (Sodium hydroxide, NaOH)
- Organic solvent

Alodizing Process

Equipment:
- Glass or plastic container
- Glass rod
- Beam balance, or spring scale accurate to one gram

Chemical:
- "Alodine 1200"
  available from:
  American Chemical Paint Co.
  Ambler, Pennsylvania
  $3.80 per pound

Anodizing Process

Equipment:
- Glass, plastic, or lead-lined container
- Glass rod
- DC power source, heavy current, 10 to 18 volt output (see text)
- 2 automotive battery cables
- Sheet of chemically pure lead (not required with a lead-lined tank)
- Insulated support rod (piece of broom handle, etc.)
- Aluminum strap stock, ½" to 1" wide, 1/16" to ⅛" thick (See Figure 5)
- Metal container for boiling water

Chemical:
- Sulfuric acid (H_2SO_4) 66° Baumé scale (undiluted)

Dyeing Process

Equipment:
- Metal container, preferably disposable
- Beam balance, or spring scale accurate to one gram
- Stove, or hot plate
- Thermometer, reading to 212°F.

Chemicals:
- Dye
  available from:
  Sandoz, Inc.
  61-63 Van Dam Street
  New York 13, New York
- Nickel acetate, of anti-leaching agent recommended by the dye manufacturer. The use of anti-leaching agents is optional, in general.

NOTES

1. The various containers called for should be large enough to allow the complete immersion of the article to be treated.
2. Use separate containers for each process.
3. It's permissible to use acids of different concentrations than those specified here, provided they aren't diluted down below the strengths of the solutions described in the text.

Exercise caution at all times. Keep in mind that these chemicals are in the same league as the B-plus in your final. Members of that league are well-behaved as long as you respect them, but they'll burn you good 'n' proper if you disregard their potency and act carelessly.

Don't begin to work until all safety measures have been complied with.

Don't pour water into an acid. This will cause the acid to spatter violently. Do it the other way around. Put the required amount of water in the tank first, then slowly add the acid while stirring the water with a glass rod.

Don't put your fingers or hands into the solutions, even with rubber gloves on. Use slings made from rubber or teflon insulated wire or hooks bent from tinned solid copper buss, 16 gauge or heavier, to hold and support the work while it's immersed in the various baths.

Don't handle the work by its edges or corners. This will preclude the possibility of slicing or piercing the gloves.

Don't leave the solutions unattended. As an added precaution, lock all the kids up in a closet or send them to Grandma's house for the day.

Don't let any unnecessary people mill around

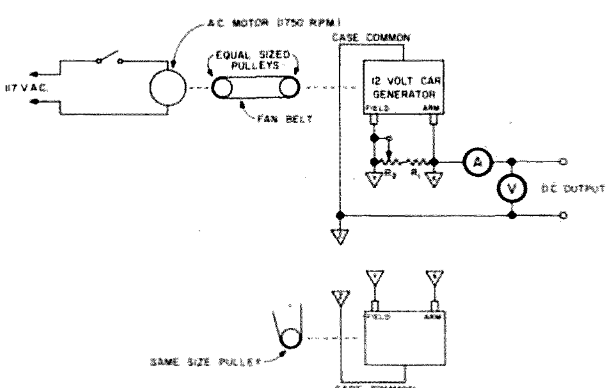


Fig. 3

For one generator:
R1 2 ohms, 10 watts
R2 25 ohms, 50 watts
Motor ¾ HP   Wire size 8GA
Ammeter 0-50 amps dc
For two generators:
R1 1 ohm, 25 watts
R2 12 ohms, 100 watts
Motor 1 HP minimum, 1½ preferred
Ammeter 0-100 amps dc   Wire 4GA
The values given above are typical for an average hook-up. They may vary as much as 50% among different makes of generators.
Maximum overload for one generator is 40 amps for not more than 20 minutes.
Maximum overload for two generators is 75 amps for not more than 20 minutes.
Maximum continuous load per generator is 30 amps.
R2 is the output voltage control.

the work area. These processes are fascinating to watch, but all it takes for a catastrophe is one extraneous individual under-foot at a critical moment.

Don't salvage the solutions when the work is finished. Dispose of them. The cost of the chemicals used in these processes is very reasonable, but the accidental damage they might cause can be very unreasonable.

That covers the subject of personal safety measures rather thoroughly. They are based on the standard operating procedures of labs and shops where corrosive chemicals are used, so the author really isn't an old worry-wart.

Now let's consider the plumbing. If your house has a cesspool or a septic tank, don't dispose of the solutions by pouring them down the drain. They will kill off all the bacteria that normally break down the sewage, and you may get stuck with backed-up drains and an incredible stink. The best way to get rid of them in this case is to bury them. Dig a hole somewhere that's clear of the cesspool or septic tank, the leaching bed, and the wll, dump the solutions in, and fill the hole up again.

If your house is served by a city or town sewer system, the solutions can be safely disposed of by pouring them slowly down the drain while the faucet is running. Let the water continue to run for at least fifteen minutes after the last of the baths goes down. This will flush out all the traps and low spots in the plumbing and give you the cleanest drains for miles around.

There's nothing wrong with rinsing the work off into the drain though, whether or not you have a cesspool or a septic tank. The tiny amounts of chemicals that might wind up down there by doing this will be so diluted that they wouldn't bother even a small amoeba.

The general procedure for passivating an item of aluminum alloy is first to pickle it and then either to alodize it or to anodize it. An alodized article can then be primed with zinc chromate and painted or it can simply be buffed with a soft cloth. An anodized piece can be left clear or dyed almost any imaginable color or metal tone. Anodized surfaces also hold primer and paint very well.

The first thing to do is to consult the list of materials and to round up all the paraphernalia for the processes that you intend to use. Suitable containers are the various plastic pails, dishpans, and waste-paper buckets available cheap at your friendly neighborhood 5 & 10. A few alternatives are plastic bleach jugs with the neck and handle cut off, photo developing trays, and borrowing the real McCoys from a

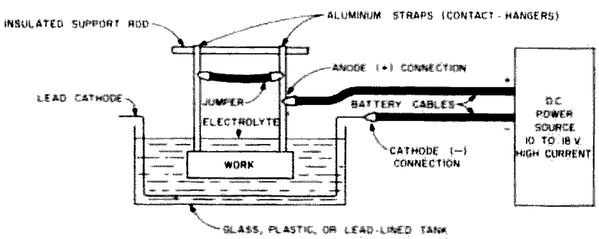


Fig. 4. Anodizing set-up

high school or college chemistry lab or a plating shop.

It's best to use commercial sodium hydroxide for the caustic etch, in preference to a household lye such as Drano. Perusal of a Drano label reveals that the product contains only 54% caustic soda and a total of 46% additives and "inert" ingredients. These extra goodies are included to prevent turning animal fat in the drain into hard soap. This is lovely for the drain, but these same additives will cause the formation of blemishes and little black things on aluminum alloys. Besides, the author's 12 ounce can of Drano cost 33 cents and commercial sodium hydroxide can be had for as little as 16 cents a pound.

The organic solvent can be almost any common cleaning solvent such as methyl ethyl ketone (M. E. K.), acetone, toluol, or methanol. Stay away from carbon tetrachloride or carbon disulfide. They're both sneaky killers.

The chemicals and some of the equipment can be obtained from a chemical or scientific supply house. Other possible sources are a plating shop, a high school or college science department, large hardware or paint stores (expecially those catering to industry), rental agencies, surplus outlets, auto boneyards, and the Yellow Pages.

After you've rounded up all the gear, set up all the processes that you're going to use. This is necessary because once the aluminum alloy has been cleaned, it's really clean. If it's left lying about while subsequent steps are being prepared, it may build up enough of a film of corrosion to affect the remaining procedures. Then you'd have to start all over again, and thin aluminum alloy parts won't stand being pickled too many times before they develop great gaping holes all over.

The first pickling or cleaning bath is the caustic etch. This is prepared by dissolving from 2 to 8 ounces of sodium hydroxide per gallon of water. Mix it up in a steel pot if you intend to heat the solution, or in a plastic container if you're going to use it at room temperature. You ought to heat it if you have lots of pieces to clean, or if they're really cruddy or scarred up. Heating the caustic etch makes it more effective and its action faster. You can get away with using it at room temperature if you have only a few pieces to do and they are fairly clean to start with. Use 8 ounces of sodium hydroxide per gallon if you plan to work the etch cold. Use 4 ounces per gallon if you heat it. Use only 2 ounces per gallon if you heat the solution and the parts are quite clean and without scratches. Stir the mixture with a steel rod until all the caustic soda has dissolved. If you intend to heat it, bring it up to a temperature of between 150° and 160°F.

The second pickling bath is the nitric dip. If you have obtained the 42% concentration of nitric acid, mix it even-Steven by volume with water. For example, if you need two gallons of the dip, put one gallon of water into a glass or plastic container, then slowly add a gallon of 42% nitric acid while the solution is being stirred with a glass rod. The resulting mixture will be 21% nitric acid. If you are using a different concentration of acid, you'll have to alter the amount of water you start with. The bath should be between 20% and 25% nitric acid.

The alodizing solution is prepared by dissolving 2 ounces of "Alodine 1200" per gallon of water. Mix it up in a glass or plastic container and stir it well with a glass rod. A card to the American Chemical Paint Company, Ambler, Pennsylvania will reveal the whereabouts of the nearest distributor of "Alodine 1200". If you happen to get hold of some other alodizing agent, prepare it according to the manufacturer's instructions.

Let's consider the dc power source necessary for anodizing before we discuss the actual set-up. Ideally it should have an output variable between 10 and 18 vdc and be able to supply between 10 and 25 amps per square foot of anodized surface. The exact current drain will depend on the composition of the alloy, the concentration of the electrolyte, the purity of the lead cathode, the voltage used, and other imponderables such as whether or not Brezhnev had borscht for breakfast. For clear anodizing, 15 volts is required, but if you intend to dye the article, the anodizing voltage will be determined by the dye that you use.

Before somebody gets all shaken up over the improbability of turning up such an exotic supply, the writer hastens to point out that any dc potential between 10 and 18 volts will produce an anodized film on aluminum alloy, and that the film so formed will effectively protect the metal beneath it. Working with a different voltage than the one needed for best results with the dye will affect the vividness

of the color, but the dye will take to a greater or lesser degree. You can always run a piece of scrap alloy through the whole process to find out how the end result will look.

The chances are that you already have a power source that can be used for anodizing. It's the family bomber, if it has a 12 volt ignition system. It will supply up to 25 to 30 amps, more if you've installed a heavy duty generator or alternator for that California gallon reposing in the trunk. If you use the car's electrical system, prop up the throttle linkage so that the engine is turning over fast enough to keep charging the battery continuously while the anodizing is in progress. Be sure to work upwind of the exhaust, and don't work inside the garage, even with the doors wide open.

Another scheme is to make up a dynamotor set using an ac motor to turn over an automotive 12 volt generator or alternator (or a pair of them, even). The hook-up shown in Fig. 3 will put out over 700 watts (at 18 vdc) for short periods with one generator, and in excess of 1.3 kilowatts intermittently with two generators. In addition, its output voltage is variable over the desired range. The generaltors can be the common, garden variety 12 volters available at the local auto junkyard, but if you use two gennies, try to get two of the same make and model.

Other power source possibilities include borrowing a heavy duty battery charger from the corner gas station, and paying a visit to the science department of the local high school or college. Undoubtedly there are other ways to obtain the necessary schmaltz for anodizing, but the author has attempted only to point out a couple of methods that can be jury-rigged from goodies around the house and neighborhood.

Prepare the anodizing electrolyte by adding one volume of 66° (Baumé scale) undiluted sulfuric acid to nine volumes of water. It is especially important with undiluted sulfuric acid to add the acid to the water, not vice-versa, in order to avoid spattering. Add the acid slowly while stirring the water with a glass rod. The resulting solution should be 15% to 18% sulfuric acid by weight, or 10% by volume. If you started with diluted acid, you will have to reduce the amount of water to make it come out right. (A gallon of water weighs 8 pounds; a gallon of sulfuric acid weighs 13 pounds.)

Using an automotive battery cable, connect the negative side of the power source to the lead electrode. If you were able to get a lead-lined tank, a separate lead cathode won't be needed, and you can connect the negative cable directly to the lead lining of the tank. Fig. 4 shows the whole set-up.

If you're going to color the anodized surface, mix up the dye according to the directions on the label. You will only need something like ¼ to 1/3 of an ounce of dye per gallon of water, so it's quite probable that a sample of the dye will be sufficient for most small jobs. Send a card off to Sandoz, Inc. for specific information on colors (they make dyes in about 100 colors, all different), samples, and the location of the nearest dealer. The mixing instructions will probably indicate a proportion like 2 grams per liter of water, so use these conversions: 28 1/3 grams = 1 ounce (avoirdupois); 1 liter = 1.06 quarts (fluid).

After the dye is mixed, put it on the stove or hot plate and bring it up to a temperature of between 150°F and 160°F. Also, fill another metal container with water and bring it to a boil. Add the anti-leaching agent to this water, if one is called for. This completes all the setting-up procedures.

Now let's look into the pickling process. Incidentally, all forming, bending, cutting, drilling, and other machining of the piece to be treated should be finished before any of these processes is undertaken. Start by wiping the work with the organic solvent and a clean cloth or a paper towel. This removes any skin oils, grease, and other residues from the surface of the piece. Now dip it into the caustic etch, using a hook or a sling to support it. The work may fizz like an Alka-Seltzer when you first put it in. Tip the article back and forth a couple of times to free any trapped air.

This bath will actually reduce the surface of the alloy. It will remove shallow scratches, and it'll feather the edges of the deeper ones

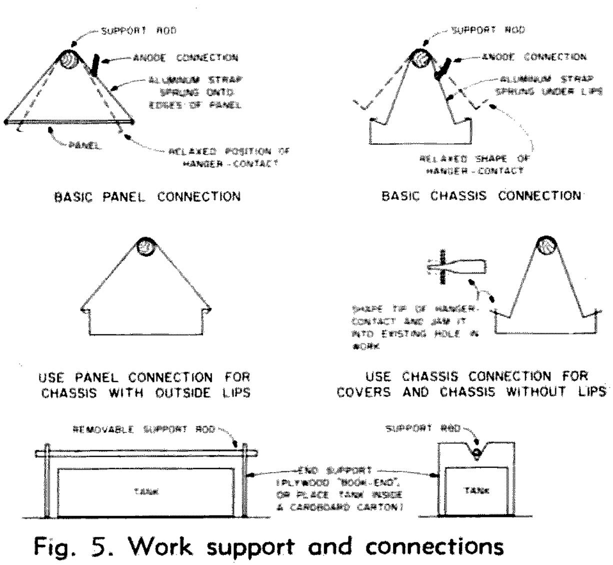


Fig. 5. Work support and connections

Fig. 6
ANODIZING VOLTAGES AND TIMES

VOLTAGE	MINUTES CLEAR	MINUTES DYED
16 to 18	15 to 15	10 to 20
13 to 16	15 to 20	20 to 25
10 to 13	20 to 30	25 to 40

so they'll be less noticeable. Leave the work immersed in the caustic etch for 2 or 3 minutes, then take it out. At this point the surface will have a smoky, faintly grainy appearance, somewhat like a cold solder joint. Rinse the piece thoroughly with running water.

Now dunk the work into the nitric dip and shift it around a bit to eliminate trapped air. This bath removes the smut formed on the surface of the alloy by the caustic etch. There may be some fizzing in this solution, too. Let the piece soak for 2 or 3 minutes, until it's bright and shiny. Then take it out and rinse it thoroughly with running water. This completes the pickling, or cleaning, process, and the work should now go immediately to the alodizing bath or to the anodizing tank.

The alodizing is accomplished by immersing the pickled part in the "Alodine 1200" solution. Tilt the work once or twice to release trapped air. Let the piece stay in the bath for 30 seconds to one minute if the solution is fresh, longer if you've done lots of parts in it. When you take the article out of the bath, it will look as though it had been sprayed with mustard. Rinse the part thoroughly with running water and hang it up to dry for an hour or so. When it is dry it's ready to be buffed or primed and painted. It can also be used "as is."

Anodizing is a bit more complex. If you aren't using a leadlined tank, immerse the lead cathode in the electrolyte. Connect the work to the positive side of the power source, using the other battery cable. The points of contact may leave visible marks on the object, so try to make the connection somewhere on the piece where possible marks won't matter. The only metal that you can use for making connections that will be in physical contact with the electrolyte is aluminum or aluminum alloy. Don't use copper or brass for these "wet" connections, but they can be used for any "dry" contacts. See Fig. 5 for some connection hints. The power source can be switched on before the work is put into the tank, because no current can flow unless the item is in contact with the electrolyte.

Now immerse the piece in the tank, being careful not to short it against the lead cathode (it might wipe out the power source). Rock the work a bit to free any trapped air. For clear, uncolored anodizing, give the item 15 volts for 15 to 20 minutes. For dyed work in general, 15 volts for 20 to 25 minutes should do the trick, but if it's possible for you to do so, follow the dye manufacturer's recommendations for voltage and time. For those of you who are using a fixed voltage other than 15 volts, Fig. 6 will serve as a guide to the proper time for the voltage you have available.

While the piece is in the tank stir the electrolyte with a glass rod. This is necessary to insure an even film. When the time is up, take the work out of the tank, disconnect it from the power source, and rinse it thoroughly with running water. The surface of the article will have a satiny appearance. This is the anodized film.

If you are going to color the item, it goes vat next. Keep the temperature of the dye as constant as you can at about 150°F. and follow the manufacturer's recommendations for dyeing time.

From the dye bath the work goes into the pot of boiling water for 15 minutes. The water may leach out some of the color, and this may lighten the shade a bit. An anti-leaching agent, added to the water beforehand, will minimize this occurrence. A dash of nickel acetate is the usual additive, but the dye people may suggest, or require, something else. When the work comes out of the boiling water, the process is finished, and the part is ready to use.

If you are not dyeing the article, it goes directly into the boiling water after you've taken it out of the anodizing tank and rinsed it thoroughly. The purpose of the boiling water is to seal the pores in the film. Let it cook for 15 minutes, then take it out. This completes the anodizing process, and the piece is ready to use.

You should promptly break down the setup and dispose of the solutions when the last item is finished. If it really goes against your grain to get rid of the acid solutions, they can be stored in glass or plastic jugs. Don't fill them up to the top, though. Leave some space in each jug for gas formation, otherwise enough pressure may build up inside the bottle to burst it. The other solutions are so inexpensive that they aren't worth the bother of storing them. Store the acid solutions, if you trouble to save them, and any unused chemicals under lock and key.

The author wishes to acknowledge the essential assistance rendered by Gus Fletcher of Sanders Associates, Nashua, New Hampshire. Without his help this article could not have been written.

. . . Kidder

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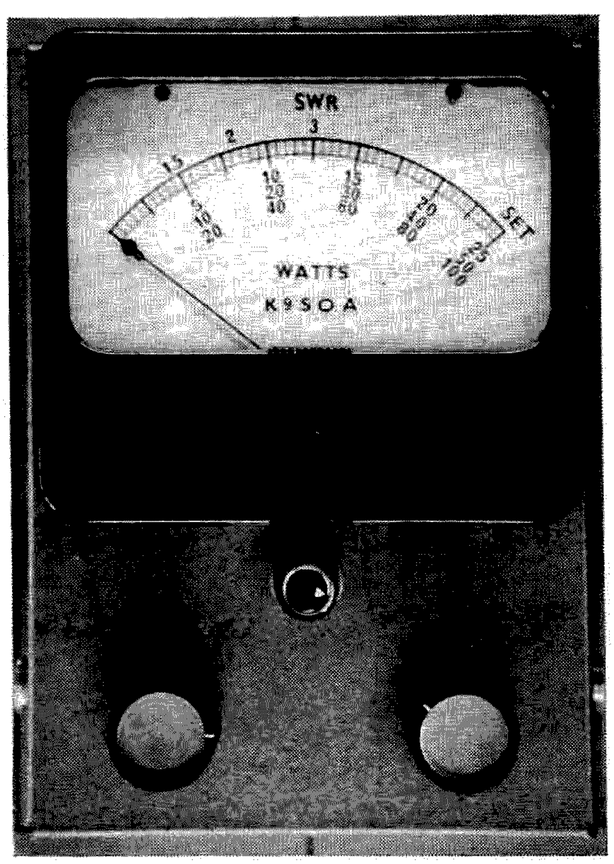
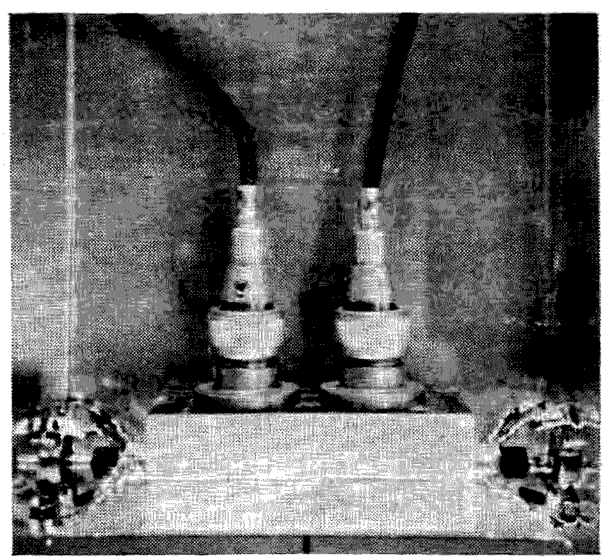
A Surplus SWR-Power Meter

The SWR of a transmission line is more important in the VHF and UHF range than it is in the HF ham bands. Unfortunately, most inexpensive SWR meters made for the amateur market aren't very useful above 30 mc. I was trying to figure out a simple solution to this problem when I noticed an ad in *73*. E. C. Hayden in Bay Saint Louis, Mississippi sells a surplus reflectometer with 200 microamp

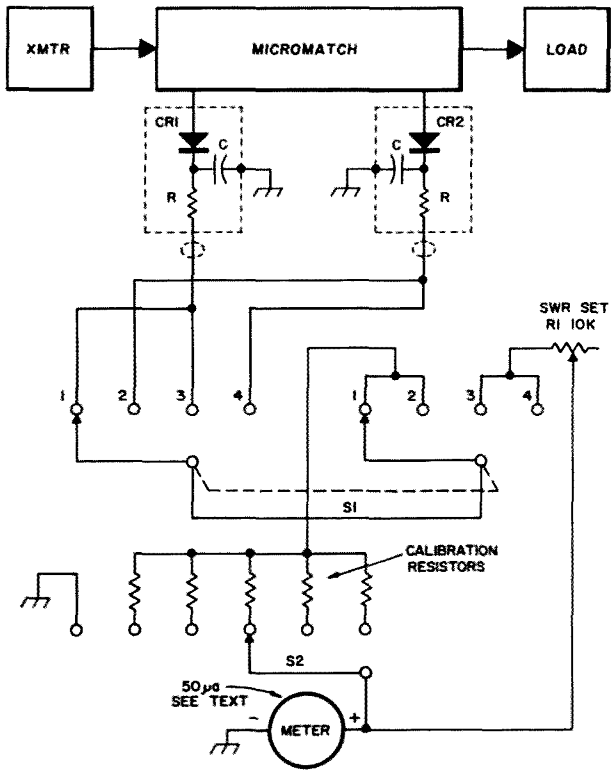




meter, diodes and even the calibrating rheostat for only $8.25. I ordered one and found that it was the Saratoga Industries Model HC 999 R which is identical to the Jones Model 574.23 Micromatch. It comes attached to a piece of RG 9 50 ohm coax and has a huge connector on one end. The other end is cut. The assembly comes from a Hallicrafters T-465/ALT-7 radar jamming transmitter covering the range of 168 to 352 mc.

I decided to use another meter and save the small 200 microamp one for another use. You can use any size meter from 50 µa to 500 µa. The more sensitive meter is necessary for low power at lower frequencies.

I mounted the reflectometer and metering circuitry in a gray hammertone Minibox, 5 x 7 x 3 inches. I used a nine position range switch

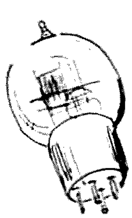


because it was available, but you can use other ranges. Since I used a 50 μa meter, I made one position of the switch a direct short to protect the meter. Switch two has four positions. The first reads forward power to the antenna in watts. Position two reads reflected power in watts. Position three is used to set the meter to full scale with R1. The fourth position reads the SWR.

You can calibrate the meter using a good bridge or with a dummy load such as the Cantenna. Remember that power readings are only good at the frequency of calibration in this type of unit. Also, the meter won't read linearly at low powers. Pick the calibration resistors with a decade box or by trial and error. It's rated as good for 200 watts, but that seems to be very conservative.

This SWR bridge will take only a little time to build and will cost less than any comparable commercial instrument. When you're finished, you'll have an excellent piece of test equipment that you will use often.

. . .K9SOA



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UHF Signal Source

The UHF experimenter learns early that the UHF ham bands don't always furnish a signal when you need them. When I build receivers and converters for 432 and 1296, I find that I need a small signal generator for alignment and band spotting. Not much power is needed for this work, so transistors are the ideal choice for generating the signal. This signal source is in three parts, a 432 source, a tripler to 1296 and a modulator.

The 432 Driver

I started with a low-cost 27 mc crystal that I found in my junk box. (Never mind how it got there!) I used my usual phase-reversing crystal circuit followed by a bunch of doublers. Lower-priced transistors were used in the early stages and the UHF ones saved for later. You really need good ones on 1296! Each doubler is biased from rectification of rf from

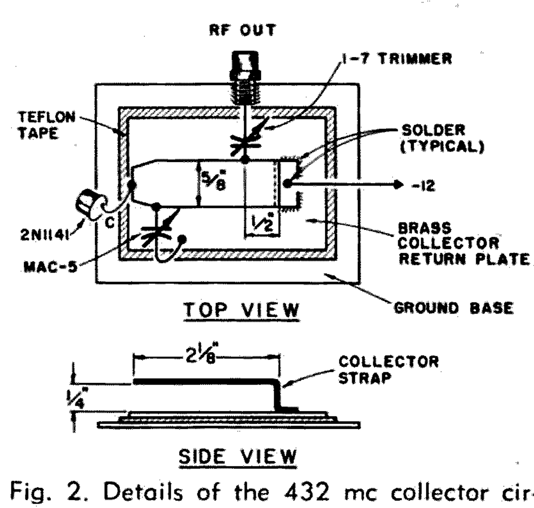

Fig. 2. Details of the 432 mc collector circuit.

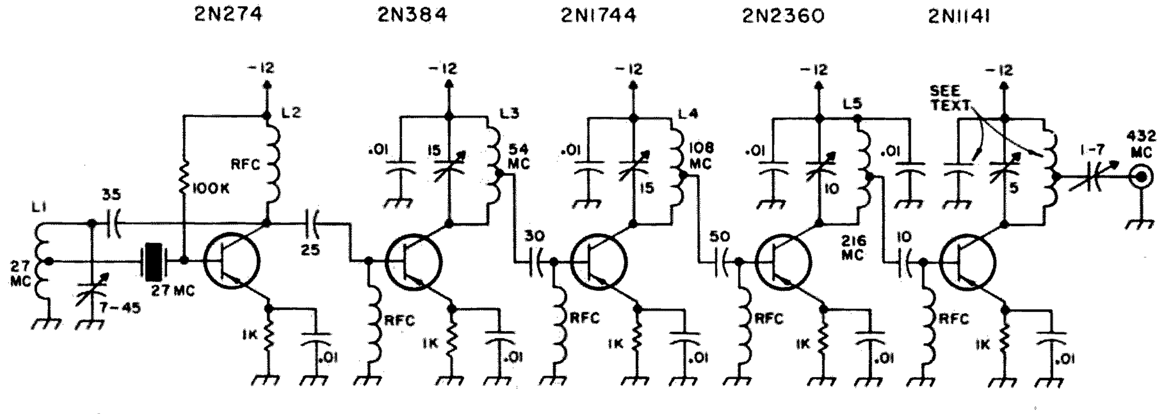

Fig. 1. Schematic diagram of the 432 mc signal source. The transistors aren't critical in most cases and other UHF and VHF ones will work fine.

the previous stage. If you need more output than this circuit gives you, use less than a 1 k resistor in the emitter, but watch out for high collector current. **Fig. 1** shows the schematic of the 432 mc generator and **Fig. 2** gives details of the 432 mc collector circuit.

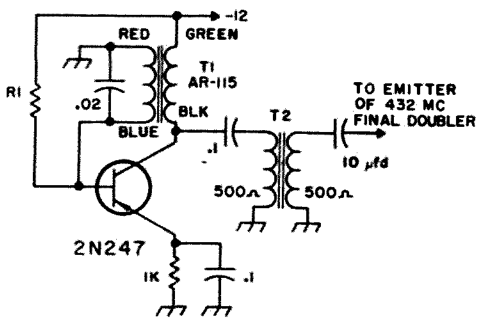

Fig. 3. The tone oscillator for the 432 mc signal source.

The tone modulator

This is a crude modulator (**Fig. 3**), but it works. The modulation transformer is not absolutely necessary, but seems to improve results. You can apply the modulation almost anywhere for this application, but modulating across the 1 k emitter resistor gave the cleanest sound with the doubler used.

Now to 1296

I built this tripler to 1296 just for the fun of it. But it worked quite well. I normally don't hold with triplers at this frequency, but it's an easy way to get 1296 mc energy from the 432 mc driver. The transistor I used was a Motorola 2N1141. It's several years old and there are better ones that are far cheaper now. But it does work on 1296. I couldn't get it to work with grounded emitter, but grounded

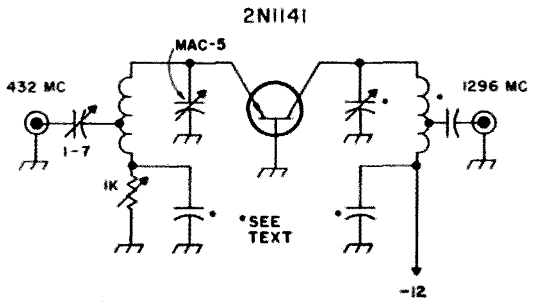

Fig. 4. Schematic of the 1296 mc tripler.

base is fine. **Fig. 4** gives the schematic but **Fig. 5** gives the details, which are vital. The input on 432 tunes very nicely. But I had to reduce the emitter resistor in the doubler to 432 to get enough drive. It ended up at 200 ohms. The collector circuit is short, but tunes smoothly. The 1296 mc output registers 100 a in the 1296 cavity in the May 73.

You might try a small amount of modulation on the 1296 mc tripler. Also a waveguide attenuator. Be seeing you on 23 cm.

. . . K1CLL

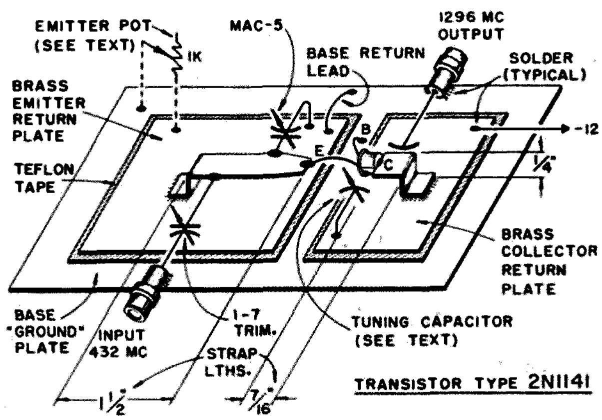

Fig. 5. Pictorial layout of the 1296 mc tripler.

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Light Bulbs for Dummy Loads

Light bulbs have intrigued me for many years. This goes back to the old bulbs with the tip on the top. The younger generation missed the fun of putting these old bulbs in a bucket of water, breaking the tip and having the bulb fill with water. This was a real dandy device; it could be used to gently sprinkle the girls with water or used as a combination hand grenade and bomb.

Now back to the present day and some comments on dummy loads for transmitters. Light bulbs have been used for this purpose for many years; however, as dummy loads, they leave lots to be desired. As you know, the cold resistance is much lower than the hot resistance. As you start to load the transmitter, the impedance is constantly changing and you cannot get a good match. Now if you try to modulate the rig, the impedance is jumping all over the place.

I do not mean to sell light bulbs short as a cheap dummy antenna. In fact, I was going to write a big, dandy article on a means of checking transmitter output by comparing the brilliance of a bulb tied to a transmitter and one connected to the line with a method of controlling its brilliance, then measuring the power to the controlled bulb and thus finding the power output. The research on this project revealed several things. First, the impedance, as mentioned before, is all over the place; and second, the Heath Cantenna is a better way. Third, it's more fun to watch a light bulb light up than to watch a meter swing up scale.

If you still like to see your transmitter light a light bulb, here are a few facts to keep in mind. Just because a bulb has a wattage rating close to the rating of the transmitter does not mean that it will be a good match. A 50 watt, 120 volt bulb is 280 ohms; very fine if you use 300 ohms feed line to the antenna and the transmitter is running at 100 watts input. If you use 50 ohm coax then you should get a 30 volt, 50 watt bulb because this has 45 ohms and they are available—still some used with the old Delco plants and lots on boats. You can figure out for yourself what bulb will be best. Just remember that most transmitters only run about 50% efficient, especially with PI output.

The following table shows what can be expected of bulbs running with less voltage than rated. From this you may be able to guess what output you have and can calculate the resistance for a given condition.

% Rated Voltage	% Hot Resistance	% Total Light
10	40	-0-
20	52	0.6
30	60	2.1
40	67	5.8
50	74	10.9
60	80	19.5
70	85	32.1
80	90	49.0
90	95	70.6
100	100	100.0

For the very low power rig there is not too much available that will give a good impedance match. Heath Company sends a No. 47 pilot bulb to use as a dummy load on the "Twoer", "Sixer," and "Tener." This bulb is rated at 6.3 volts and .15 amps. Resistance then is 42 ohms, which is a fair match for 50 ohms output but the power is *only* 0.95 watts and I never heard anyone complain that the 5 watts input burned out the dummy load.

Christmas tree bulbs rated at 7½ watts are no good because the resistance is 2000 ohms. I could not find a good automotive bulb, resistance all too low. The old series string Christmas bulbs are still available and are good for 4.8 watts at 47 ohms.

. . . W8QUR

William Goldsworthy W6BUV

VFO Stability

Do you want to get a little more stability out of your existing VFO or do you just want to build a decent one from scratch? Let's examine in some detail just what it is that separates us from that one cycle stability that we all dream about and then let's see what can be done to approach our goal. Of course, in the hobby of ham radio, we don't need quite the stability of a broadcast station, but with the wide use of single sideband we do need a pretty high degree of oscillator stability.

Instability Sources

The gremlins that prevent us from obtaining that no drift oscillator can be separated into three broad classes: effects from temperature variations, effects from mechanical variations, and effects from phase variations.

Temperature Stabilization

Of these variations, probably the one most often encountered is the drift associated with temperature variations. Since the primary parameters determining the frequency of oscillation are the inductance and capacitance of the oscillator tank, it is necessary to prevent or compensate their variations in order to eliminate most of the drift that occurs from temperature changes.

Isolation of the oscillator tank circuit from heat sources and the use of temperature compensation must be employed to reduce the effects of temperature on the operating frequency. It is possible to place the oscillator tank external to the rig for excellent heat isolation, but for the sake of convenience and compactness, it should be included as an integral part of the rig. Tank circuit placement should, however, be made so that heating is kept to a minimum.

It is the inductance of the oscillator tank circuit that is responsible for the majority of the temperature drift problem. The inductance, almost invariably, has a positive temperature coefficient, while capacitors can be selected with almost any temperature coefficient, including zero. Since capacitors are available in a number of negative temperature coefficients, the greater part of the oscillator frequency drift with temperature can be removed by using a capacitor having the correct value of compensation to balance out the positive coefficient drift of the tank inductance.

Schemes to accomplish temperature compensation of an oscillator tank circuit are shown in Figs. 1 and 2. The circuits shown are that of a Clapp oscillator. Temperature compensation is provided in the circuit of Fig. 1 by paralleling the usual tuning capacitor with a series combination consisting of small negative temperature coefficient capacitor and a zero temperature coefficient padder. Increasing the capacitance of the padder will increase the amount of negative temperature compensation provided by this series combination. The shift in frequency associated with this adjustment must, however, be corrected by resetting the bandset capacitor CB. To eliminate this necessity, it is possible to use a specially designed split stator padder with the dual capacitor arrangement shown in Fig. 2. This will allow compensation to be accomplished with little or no shift in the frequency of oscillation. Excellent temperature compensation can be obtained with either of these arrangements only if pains are taken to keep all of the frequency determining parameters in close physical proximity so as to insure their uniform temperature variation. In other words, you don't want the inductor to heat up faster or differently than the capacitors or vice versa.

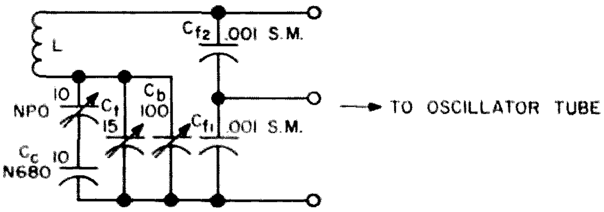

FIGURE I

RF Heating

There is also another little temperature problem associated with the oscillator inductor that may give considerable trouble. This is the tendency for the inductor to heat rapidly when RF current flows in it. Although temperature equilibrium will be reached in several minutes, this effect may be bothersome where oscillator coils are switched for changing bands.

Several precautions, if taken, will avoid this pitfall. These are the use of large wire sizes in winding the inductors, the use of coil form materials providing good RF insulation and good thermal conductivity such as ceramic, and the operation of the oscillator at a low enough level to minimize RF current heating.

The use of plastic materials and air-wound coils, which provide good RF insulation but poor thermal conductivity, should be avoided in an oscillator tank circuit, especially where oscillator coils are band switched. It is preferable to use coils tightly wound on ceramic forms where the ceramic is in good thermal contact with the surrounding chassis, to provide for a maximum equalizing of temperature in the vicinity of the oscillator tank circuit.

Mechanical Stability

Even if we have done the greatest job in the world to temperature stabilize the oscillator frequency, we still may not have arrived at our desired degree of stability. We still must consider mechanical and phase stability. In order to avoid mechanical instability, it is important that frequency determining components and wiring be mounted so as not to be subject to motion from shock or vibration; that hardware such as shafting, gears, or bushings in the vicinity of the oscillator coil be placed and operated so as not to produce variable or intermittent contact or coupling; and that the oscillator tuning arrangement be stable enough to provide smooth tuning with good reset ability over the desired tuning range. This means that all frequency determining circuits should be wired with fairly rigid wire, that the frequency de-

termining inductances and capacitors should be rigidly mounted, and that a sufficiently rigid chassis should be used to insure adequate rigidity for component mounting. Control shafting used in close proximity to the oscillator coil should preferably be non-metallic or at least insulated in such a fashion from the chassis so as not to form shorted coupling loops that may couple to the oscillator tank or form ground returns that may parallel the chassis ground in the vicinity of the oscillator coil. A ground formed by a metal shaft passing through a bushing or hole in a panel may be quite intermittent, resulting in considerably frequency instability when the impedance of this ground palallels grounds in the vicinity of the oscillator coil, or when it provides inductive coupling to the oscillator coil.

Even the bearings and wipers used on the oscillator tank tuning capacitor should be carefully scrutinized to make sure that the impedance of the rotor return circuit does not fluctuate with rotation. Many capacitors have very poor return circuits and the ones using ball bearings to form part of the ground return circuit from the rotor should be avoided, since these bearings do not always make uniform contact. Variable capacitors that use wipers can give exceptionally good stability if care is taken to see that the wipers are making good contact. It is however, preferable to use tuning capacitors that do not use wipers, such as insulated rotor, split stator types. Even when a good quality tuning capacitor is used, care must be exercised in coupling it to a dial mechanism.

A number of difficulties can arise if the dial mechanism forms part of the ground return circuit from the tuning capacitor's rotor. Variations in the ground impedance of the dial mechanism may cause undesirable variations in frequency with rotation.

Some means should be provided so that the dial mechanism does not palallel the tuning capacitor's ground return. This can be accomplished by providing a solid insulated coupling between the capacitor's rotor and the dial mechanism. Poor alignment between dial and capacitor can also cause considerable frequency instability when springing and back lash result. Single bearing capacitors which are quite subject to springing should never be used as variable tuning capacitors in oscillators, but instead, the use of double bearing units or ones in which the capacitor is constructed as an integral part of the dial mechanism should be employed.

Another precaution often neglected is to make sure that grounding to the chassis be made at the place of intended contact only from any of the components in the frequency determining circuits. Often times, a lead from a fixed tuning capacitor may accidentally make brushing contact with the chassis at a short distance from the point of intended contact. Any flexing motion or temperature change may cause this contact to vary, resulting in a variation of the inductance of this lead and therefore the frequency.

Phase Stability

So far, we have considered problems only with the frequency determining tank circuit. It is equally important that the oscillator tube be connected to and operated in such a fashion with this tank circuit, so as to minimize frequency variations associated with tube parameter changes, output loading, and output tuning. Since the oscillator tube must supply the losses suffered in the oscillator's tank circuit to sustain oscillation, the phase and amount of feedback applied to the oscillator tank, as well as changes in tube parameters, will have an appreciable effect on the operating frequency. By careful design, these effects on frequency can be greatly minimized. This can usually be achieved by reducing the coupling between the oscillator's frequency determining tank cricuit and the oscillator tube. Reduction can be accomplished by using an oscillator tube having great power gain, by using an oscillator tank circuit having low losses (Hi-Q), and by using only enough coupling between oscillator tank and tube to sustain stable oscillation.

The small degree of desired coupling between oscillator tank and tube is usually obtained by connecting the tube elements across a small part of the total capacitance of the tank circuit. Although a reduction in coupling would also exist by tapping across part of the inductance for the tube connections, parasitic difficulties are quite likely to be encountered, especially when the grid is tapped across only part of the inductance. The arrangement used in the Clapp oscillator, Fig. 3, will provide control over the coupling by varying the ratio between the total series value of Cf1 and Cf2 and the total parallel value of Ct, Cc, and Cb. Less coupling will result when the ratio of these two capacitive reactances is high and more will result when the ratio is low. It is desirable to keep the ratio as high as possible while still maintaining oscillation.

Q of Tank Circuit

In order to provide a tank circuit with the extremely Hi-Q needed for stable oscillator operation, it is necessary to use capacitors and inductors having Hi-Q characteristics. Most

good quality capacitors are of sufficiently Hi-Q to give no worry, but providing an inductor having Hi-Q characteristics is a little more difficult. An inductor having Hi-Q characteristics can be made by winding with reasonably heavy copper or silver wire on a low loss coil form, having reasonable diameter, with as much spacing from shield can or chassis as possible. In addition, all metals, especially magnetic ones, should be kept away from the immediate vicinity of the inductor if at all possible.

Frequency variations resulting from tube parameter changes occur due to mechanical changes in the element spacing with temperature, to the change in applied anode and filament voltages and to component variation. Even when the coupling between oscillator tank and tube are optimized, there will still be some oscillator frequency shift associated with loading, tuning, and voltage variations. To minimize these effects, it is necessary to provide sufficient isolation between frequency determining circuits and output circuits to prevent feedback coupling of these circuits. A convenient method of attaining some of this desired isolation is by the use of a screen grid tube, where the screen acts as the oscillator's anode and coupling to the output circuit is

through electron flow to the plate circuit. Output can be obtained either at the fundamental or at the harmonics of the oscillator frequency.

Another way of attaining isolation is by the use o fa buffering tube following the oscillator tube. The additional tube can be either a cathode follower or an amplifier. The isolation desired may be hard to attain if the output circuit is tuned to the oscillator's fundamental since feedback may still exist from this output circuit to the frequency determining tank, through the tube's inter-electrode capacity or through other means of coupling that may exist. By operating the output at a multiple of the oscillator frequency, isolation is automatically provided, since the output circuit now operates at a frequency where feedback that does occur will have little or no effect on the frequency stability.

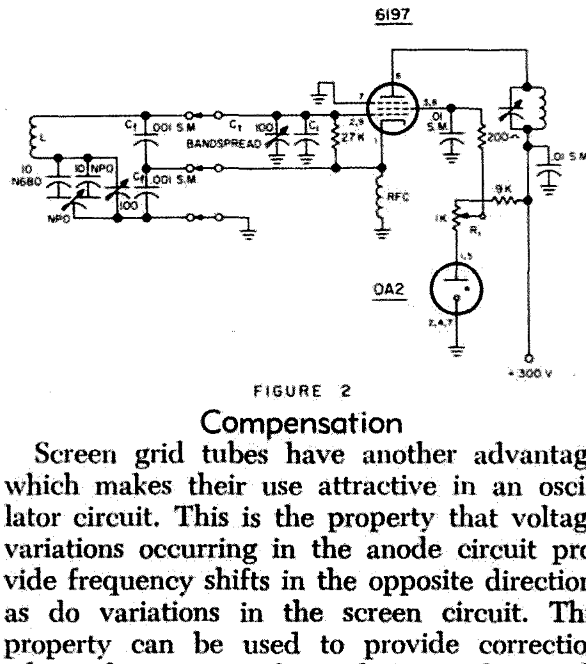

FIGURE 2

Compensation

Screen grid tubes have another advantage which makes their use attractive in an oscillator circuit. This is the property that voltage variations occurring in the anode circuit provide frequency shifts in the opposite direction, as do variations in the screen circuit. This property can be used to provide correction where the screen voltage, but not the anode voltage, is regulated. A Clapp oscillator circuit using this means of compensation is shown in Fig. 2.

Potentiometer R1, the zero frequency shift balance control, which comprises about 10% of the bleeder resistance from A+ to the VR tube, applies a varying percentage of unregulated voltage to the oscillator screen as the potentiometer's swinger is rotated towards the B+ and when R1 is correctly adjusted, there will be just enough screen voltage shift accompanying anode voltage shift to result in zero frequency shift. Where anode voltage can also be regulated, this form of compensation would not be needed.

Oscillator Filament Voltage Regulation

Usually, shifts in the oscillator tube's filament voltage have much larger effects on frequency than do shifts in the anode voltage Variations in this voltage not only cause large changes in the power gain of the oscillator, but also result in changes of the physical spacing of the tube elements. Variations in the spacing from cathode to grid, resulting from thermo-mechanical expansion, cause the most bothersome change. Since there is no easy way to compensate out this variation, it is imperative to provide some means of filament voltage regulation for the oscillator tube where large voltage variations are encountered. The extremely poor regulation of an auto's electrical system will require the use of oscillator filament voltage regulation. A simple regulator can be made by using a zener diode, and if more elaborate means are needed, a transistor voltage regulator can be provided.

Parasitics

Even after all of the aforementioned precautions have been taken in building a stable oscillator, it still may operate poorly and erraticly. This can be very often due to parasitic oscillations occurring at some other frequency than the desired one. The usual methods of parasitic suppression should never be applied to an oscillator, such as placing resistors or L-R networks in series with the tubes electrodes, as these additions can greatly reduce the Q of the frequency determining tank circuit to which the tube is connected. This reduction of the oscillator tank circuit Q will occur because the capacity existing between tube electrodes forms part of the tuning capacitance of the oscillator tank circuit, and any series resistance will provide loss when the high circulating currents of the Hi-Q oscillator tank circuit pass through these series resistive-capacitive circuit formed by the parasitic suppressors.

The proper approach to eliminating parasitics in an oscillator is by proper circuit layout, that is, the avoidance of long leads from the frequency determining tank circuit to the tube and by proper placement of the components comprising the tank circuit. Sometimes, where lead lengths are long from the tuned circuits to the tube, where band switching is applied to a Clapp oscillator circuit as in Fig. 2, parasitics can be avoided by placing a small portion of the grid cathode feedback capacitance directly at the base of the oscillator tube. This will prevent the oscillator from oscillating at a frequency determined solely by the lead inductance appearing between the tube and oscillator tank and the oscillator tubes inter-electrode capacities.

Capacitors

By-pass capacitors used in an oscillator circuit should be of good quality, and hi-C ceramic ones should be avoided, since these units exhibit large capacity variations with applied voltage. Be safe, and use silver micas.

Bandswitching

A word of caution about bandswitching of oscillator tank circuits. If this is to be done successfully, that is, with good resettable stability, it is preferable to do all of the switching in the low impedance parts of these tank circuits. Fig. 2 shows such an arrangement used with a Clapp oscillator. C1 is placed from grid to ground for parasitic suppression, and Ct is a band spread capacitor which is placed across the feedback capacitors to simplify the band switching arrangement.

The Clapp oscillator is not the only type of circuit providing excellent frequency stability, but it is used as an example; since it derives its operating stability by loose tube-tank circuit coupling in the same general manner as do other stable oscillator circuits of the Franklin and other varieties.

Hi-C or Lo-C

There is another problem often raised about whether to use a high C or low C tank circuit. There are some advantages to either type of operation. As the C of the tuned circuit is increased, circulating currents increase for a given circuit Q, causing greater RF inductor heating, but on the other hand, the increase of tank circuit C greatly reduces the effect of tube input capacity variation on the frequency of oscillation. Since it is this input capacity variation that produces one of the largest single instabilities, the advantages of high C operation greatly outweighs the disadvantages.

Although this discussion has been confined to vacuum tubes, most of it applies also to transistors. Transistors are generally bad choices where extreme frequency stability is desired, since they will provide an order of magnitude poorer stability than that obtainable from vacuum tubes.

Conclusion

I certainly hope that by writing this article I have touched on enough of the basic problems involved with oscillator stability, that it may result in applying some of this information to correct some of your existing stability difficulties or to help you in the design of some of your future rigs. I am sure that I have not covered everything possible, but I do feel that this subject has not been extensively enough covered in past articles describing oscillators.

. . . W6BUV

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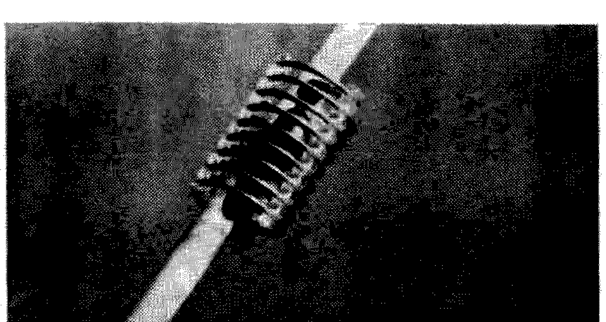
A 6-10 Combo Mobile Whip

I had for a long while wanted to operate on ten and six meters mobile, but the idea of having to use two different antennas on the car, and being too conservative to want to exhibit an eye catching or traffic stopping car, I kept postponing the act. Finally I undertook the rig construction, figuring to use the brute force of fifty watts on six with the ten meter whip to try to get through.

The modifications, or re-construction of my "Hanky Box" (see 73, Jan. '62) was near completed when the idea struck! Traps! Trap antennas are not a new subject, but I can't recall ever having seen one used with a mobile whip. The idea was to insert a high impedance trap at the 59" spot of a ten meter whip, to isolate the upper part of the antenna for six meter rf and have insignificant impedance to 10 meter rf. This should effectively make the whip appear to end at the 59" length for six meters, and still be good for ten. On paper it looked promising so the only answer was to try it and see what results could be had.

The first thought was to use a steel whip; cut it and insert the trap, and reassemble with plexiglass or the like as re-inforcement.

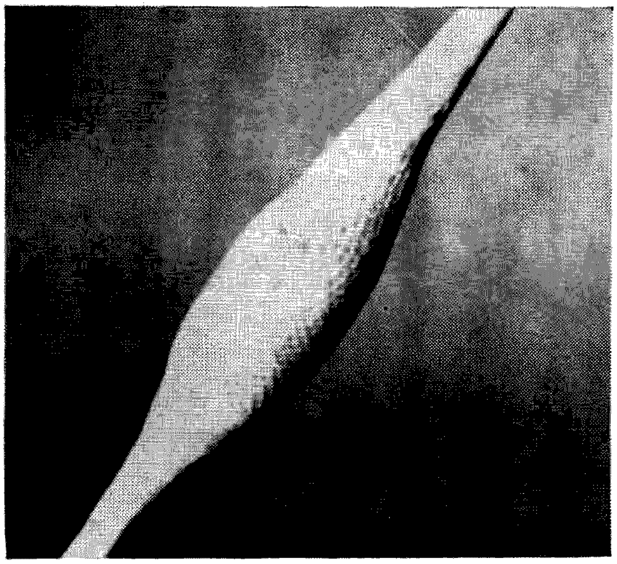


The weight of the steel made it soon apparent that a mechanically strong junction would be hard to come by. Next, I decided to try it with my 8′ Wonderod (Shakespeare-Columbia) whip, which is made of fiberglass.

I measured up the 59″, which would constitute the normal length of a six meter whip, and began cutting a slot into the fiberglass approximately one inch long, and one-eighth inch wide. I used alternately a small file, razor blade, and the hole making blade of a scout knife to finally expose a one inch length of the wire running up the center of the whip. Looking for any easier ways to do the job, I could only suggest that if a slow speed drill press is available it is possible to set the penetration to slightly less than half the diameter of the whip, and cut away the bulk of the slot with the drill. Once the wire was bared, I broke it in the center, bending each ½″ out at right angles, and applied solder to re-inforce it and prevent breaking of any of the strands.

Next came the trap. I wanted it to resonate at 50.5 mc, the approximate center of the portion of six meters I would be using. I used a 15 mmfd 3000V disc ceramic capacitor and 8 turns of a miniductor ¾″ diameter, 8 t.p.i. (B&W3010). When the dip was exact, I separated the coil and capacitor, and inserted the capacitor into the slot of the whip and wedged it in as securely as possible. The coil was slid down over the whip and both were connected to the original whip wires. The theory and procedure for trap antennas may be found in the more recent editions of the ARRL handbook.

Next came the trials, and happily the combo whip performed identically on both bands as



did unmodified whips cut for each band. One thing I forgot to consider on this prototype, but which can easily be handled in future antennas, was that I was going to use a spring with the 8′ whip to facilitate garaging the car at night and the 6″ height of the spring causes the whip to be electrically long. The effect of this lengthening was more apparent on six than ten, creating almost ½ an "s" unit difference on the home rig compared with no spring. This led to more tests to prove its occurrence, and when I was satisfied the whip was not the cause of the loss, filed the results away for future antennas. To minimize the spring effect I substituted one of the newer "Mini-Springs", 4″ high and noticed some improvement.

I finished off the job by buying a fiberglass boat repair kit, and molded the trap inside and out with white fiberglass; this both sealing the trap from weather and regaining any strength lost by cutting the slot. In lieu of the boat repair kit, fiberglass auto body repair kits are more readily available, and some of these are much easier to handle and apply with neater results. One always seems to think of easier ways to do something after having done the job, never before. The result now is an unobtrusive combination whip for ten and six which gives full quality performance on each band. The idea could be expanded for six and two meters, or even ten, six, and two, I guess, and may well be applied to CD purposes.

Acknowledgement is tendered to K3ADH, Bob Patterson for the photos, and K3LDL (my XYL) for the help in making the performance tests, and enduring my workshop hibernations during the design and construction days.

. . . W3GSC

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How to Screen Modulate

Arguments about screen modulation versus plate modulation have been going on among the AM gang for many years, and many operators have formed definite and closed opinions on the subject.

However, the apparent economy of a screen-modulated rig as opposed to one with a high-level modulator is still attractive to quite a few fellows, so a roundup of circuits with which to accomplish this aim appears to be in order.

Before we begin to examine the circuits, though, we ought to set the records straight on a few points which may have gotten lost in all the arguments back through the years. Many people consider "screen modulation" and "lousy audio" to be synonymous. Frequently, they are. But not always. Employed properly, screen modulation can produce results indistinguishable from any other type of AM. Best proof of this is that not a few commercial AM broadcast stations use screen modulation; one, for instance, is KFI in Los Angeles. These people must prove their performance to the FCC, and "lousy audio" is unacceptable.

However, accomplishing this goal of perfect audio with screen modulation is *not* so easy as getting good audio with the high-level types. In general ham practice, screen-modulated rigs tend to distinguish themselves by a lack of audio quality. Part of the problem lies in modulator design, and we'll look into that in detail in these pages. The rest of it lies at the operator's door. We'll tell you how to overcome this too; *doing* it is up to you.

A good starting point for examining screen-modulation circuits would be to determine the basic principles on which they work. In doing this, we're going to take a step "backward" and talk about AM as if it were a single carrier wave of varying amplitude, rather than using the more correct approach of considering the carrier and its two sidebands. We have a reason—this makes it much easier to see how the screen-modulation process works.

We know that in a high-level modulated AM rig, which is completely linear and is being modulated 100 per cent both positive and negative by a sine-wave signal, the *instantaneous* rf power out at the positive modulation peak is four times as great as at

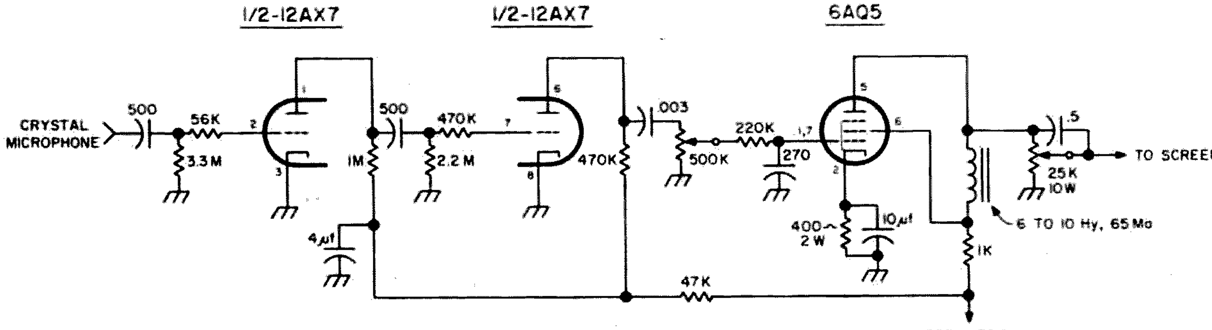


Fig. 1. W6AJF constant-carrier modulator.

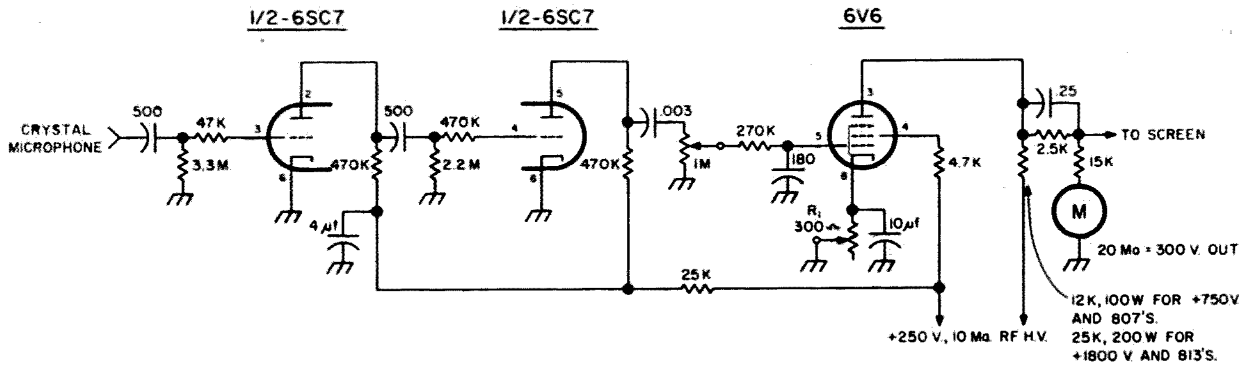


Fig. 2. Controlled-carrier modulator if R1 = 0; constant if R1 = 300. W6AJF.

the carrier level, and at the negative modulation peak drops to zero.

In the plate-modulated rig, this is accomplished by adding the audio voltage to the dc supply of the rf final amplifier, so that at positive audio peaks the final gets twice as much voltage as it does in the absence of audio, and at negative peaks the final supply voltage drops to zero. To the power supply, a Class C final looks exactly like a resistor, so when the voltage is doubled the instantaneous current will double also, giving four times the power in.

Dc-to-rf efficiency of the final remains the same (approximately 70%) throughout the process, so if our carrier-only power input to the final is 100 watts we will have about 70 watts of rf out. At positive modulation peaks, power in rises to 400 watts and we have 280 watts out. On negative peaks, power in and power out both drop to zero.

In the high-level modulator, we vary the rf power output by changing the dc supply voltage to the final. However, anything which will vary the rf power output in the same manner from the same af input signal will produce exactly the same results at the far end of the contact. Once we have a 70-watt signal going out which rises to 280 watts on positive modulation peaks and drops to zero on negative peaks, the other fellow's receiver couldn't care less how we got it!

So let's see what happens if we vary the screen voltage in an rf final. With normal screen voltage, we get normal rf output. If we reduce screen voltage, rf output drops also. This means that our screen-voltage level can be used to control, or modulate, the outgoing rf.

However, if we try it on for size we find that it does *not* control the output just the way we want it to. The audio signal going into the modulator varies from zero up to a positive peak and back down to a negative peak. This means that, if added to the screen voltage through a modulator, it can at best make the screen voltage swing from the resting value up to twice that resting value, and back down to zero.

But doubling the screen voltage of the tube in the final will *not* increase its power output by four times. Just how much it will increase the power output depends on the tube, and on the screen voltage at which we started. The average change appears to be about 2½ times.

And this amount of power change, in comparison with the four-time change we need, means that (at this point anyhow) the modulation is going to be extremely distorted.

At this point it should be clear that if we had a tube available which could be made to draw four times the current when the screen voltage doubles, then it could give the same output and efficiency with screen modulation that it would with plate modulation. The procedure would be to operate it at double normal plate voltage (the level reached by the plate during positive modulation peaks) and with an average current of half that used in plate modulation. The combination of double voltage and half current would give the

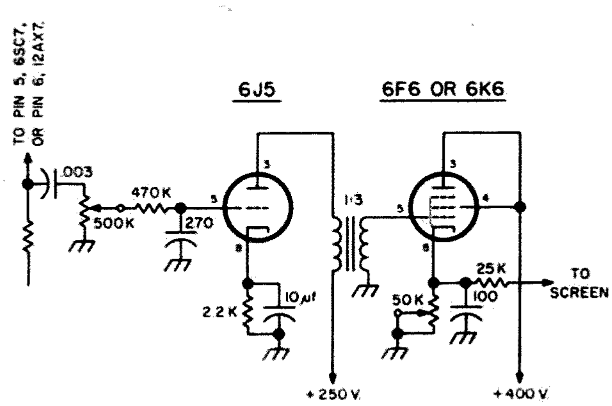


Fig. 3. W6AJF controlled-carrier gating modulator.

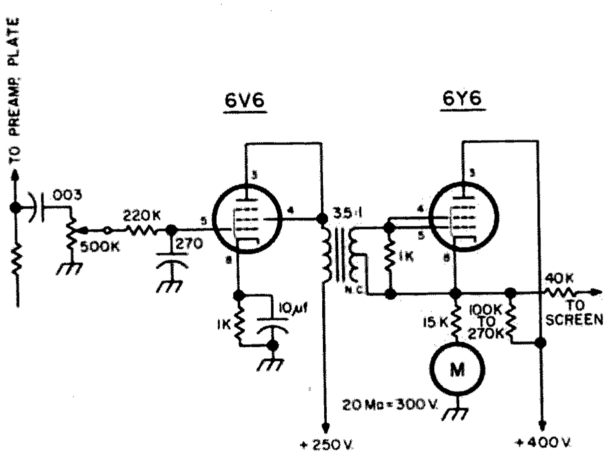


Fig. 4. Improved controlled-carrier gating modulator by W6AJF.

same power output as the plate-modulated version, in the absence of audio. Audio peaks would drive the tube up to four times the current level, reproducing the conditions which exist at high-level modulation peaks, while negative peaks would drop current to zero and reduce power output to zero. However, it doesn't appear likely that any such tube will be available in the foreseeable future.

Which means that to get good-quality screen modulation, we must vary something *besides* the power input to the final. One thing we can vary is the efficiency of the final stage.

Let's assume that our final-amplifier tube is one which draws just double normal plate current when screen voltage doubles. If we can set the stage up so that it has normal 70-per cent efficiency under peak-modulation conditions, but the efficiency drops to half or 35 per cent at the carrier level, let's see what happens:

Our 100 watts input now gives only 35 watts out at the carrier level. Positive modulation peaks double the plate current, giving us 200 watts in, and out 70-per cent efficiency at this level gives us 140 watts out. On negative peaks, of course, output is zero.

We now have our 4-to-1 ratio back, and the only difference the fellow at the other end can find is that our signal is 3 db down from its original level.

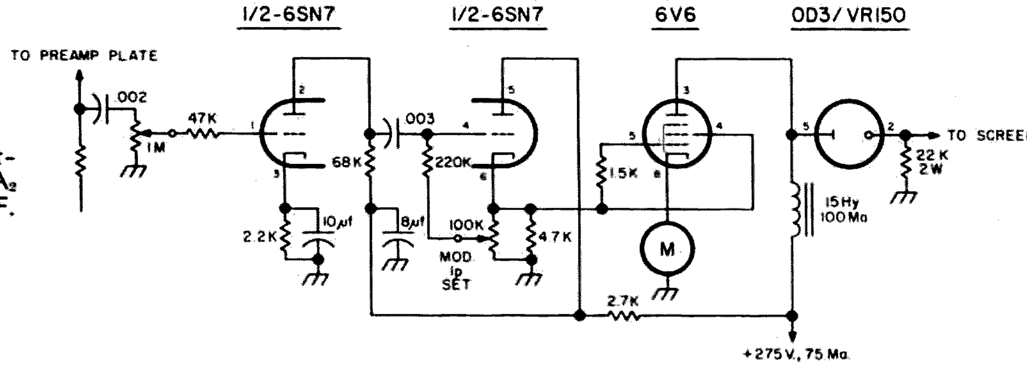
Actually, we don't do it just exactly this way. As mentioned before, the plate-current-to-screen-voltage ratio varies with many factors, so the actual adjustments are done on-the-air and everything gets twiddled around a bit until the scope shows us the best linearity of modulation we can get. But it works on just this principle of varying efficiency. We load heavily to produce low efficiency at carrier level which will rise as power level rises, and drive to allow enough rf input to saturate the stage even at maximum power level. And all the adjustments are critical.

Let's go back a bit though and see what side effects we have brought on. Our original 100-watt 70-per cent-efficient rig had only 30 watts dissipation in the final tubes. A pair of 6146's could handle that with room to spare, and a single one might do it if you didn't mind overloading it a trifle. But when we went to screen-modulation, we found 65 watts being dissipated in the tubes. This means more than twice as much power lost in the tubes, and also shows that we can't hope for much more carrier power out than half the dissipation rating of the final tubes. One 6146, screen modulated, will give only about 12 watts out and shouldn't get more than 36 watts in. An 813 will give 75 watts out. Efforts to get more power output will result in poor audio, short tube life, or both. And this is one of the big disadvantages of screen modulation.

It's well known that tubes can stand short overloads without harm. If we held the input power down on standby, yet brought it up only while talking, we could run higher power levels. This is the reason for what is known as "controlled-carrier" screen modulation. It holds carrier level down, yet automatically raises the carrier with speech so that efficiency remains more or less constant. You might say it applies the 2½-to-1 screen-voltage-to-plate-current factor twice, so that we can get the 4-to-1 ratio needed.

With controlled carrier, we can run out 100-

Fig. 5. Constant-carrier class A_2 modulator. W6AJF.



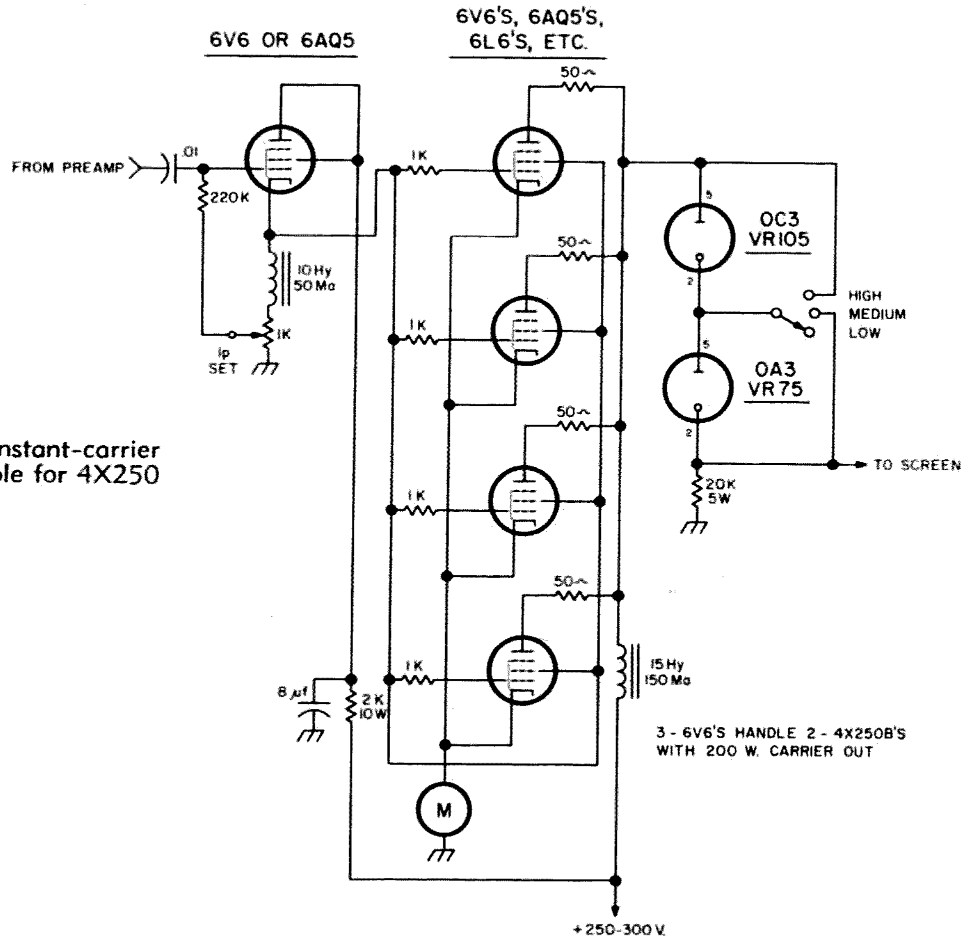


Fig. 6. High power constant-carrier class A_2 modulator suitable for 4X250 series RF tubes.

watt rig with an input on standby of only about 36 watts, giving us 12 watts out and dissipating 24 in the tube. When we talk, input rises to 100 watts and audio-peak output power can be up to 140 watts. The 65-watt dissipation taking place in the tubes between syllables won't hurt, because the average input goes back down toward 36 watts as fast as we stop talking. We're still 3 db down from high-level modulation, but we don't have to change from a 6146 to a 4-65 just because of plate dissipation.

Controlled carrier does have some disadvantages. The S-meter at the other end will flicker with speech, and so will the plate meter. You can determine power input only by loading up for CW and making an educated guess from that (the SSB technique would also be applicable). On marginal contacts, the carrier may drop out entirely between words, which is disturbing to the listener. But it doesn't have to sound bad!

Practical system modulation circuits

Having taken a brief journey through the why and how of screen modulation, let's look at a dozen selected screen-modulation circuits. Of them, six are the work of W6AJF, who has probably done more than anyone else with screen modulation. All will work.

The circuit in Fig. 1, using a 12AX7 and a 6AQ5, is a constant-carrier clamping-type modulator which will handle an 829, one or two 807's, a 4-125A, or an 813. The resistors in the 12AX7 grids make this stage act as limiter on large signals and a straight amplifier on low-level inputs, while the RC network in the 6AQ5 grid is a low-pass filter to remove the audio harmonics created by any clipping. Audio voltage to swing the screen is developed across the choke, and the 25K potentiometer or adjustable resistor is used to set the screen voltage to the proper value. The .5 μf capacitor across the upper half of the pot allows the audio modulating voltage to pass without attenuation.

The circuit of Fig. 2 is similar to that of Fig. 1, except that the choke is replaced with a high-wattage resistor which should be mounted away from all other components. The value of this resistor must be chosen for proper screen voltage on the modulated stage; R1 in the 6V6 cathode gives a fine adjustment of screen voltage, but is intended as a controlled-carrier device. With R1 shorted out, carrier level is low in absence of audio.

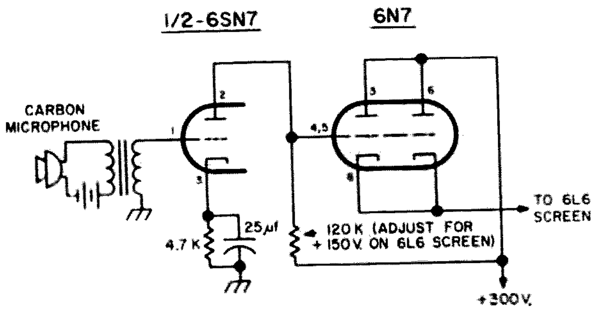


Fig. 7. Super simple gating modulator by W6MTY.

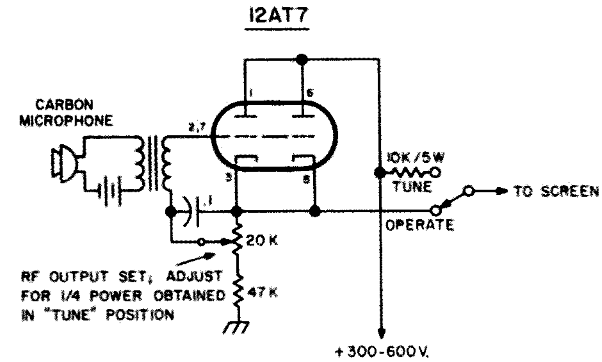


Fig. 8. Constant-carrier, one tube gating modulator.

With R1 near full resistance, carrier is constant.

When examined on a scope, the circuit of Fig. 2 shows little negative-peak modulation present at all. This represents considerable distortion, but in some types of rigs the circuit simplicity warrants acceptance of some audio distortion. Positive peaks remain linear up to 130 volts output, and tend to flatten above that point.

Both Fig. 1 and Fig. 2 are shunt-type, or "clamping" modulators. The series, or "gating," type usually offers better overall linearity.

Fig. 3 shows a simple gating-type modulator. Its input comes from a preamplifier similar to the 12AX7 stage in Fig. 1 or the 6SC7 in Fig. 2, and is amplified still more by the 6J5. The gating modulator is a cathode follower, which means that its grid voltage must swing a little wider than the swing desired on the screen, so a 1-to-3 step-up transformer couples the 6J5 to the 6F6 or 6K6 gate tube.

The 50k pot in the cathode circuit is set for cut-off bias on the gate tube, typically around 30 volts. This also sets the modulated screen voltage at this low level. Audio applied to the grid lowers the internal resistance of the gate tube, so that the cathode voltage rises, giving us carrier control. Like the circuit of Fig. 1, this works nicely with an 829 or two 807's. It is not usable with tubes having negative screen currents over any part of their operating range, such as the 813 or the 4X150 series.

A somewhat improved gating modulator is that shown in Fig. 4. It differs from the Fig. 3 circuit mainly in using a Class B gate tube rather than a Class AB_1 hookup. This, in turn, requires a power driver to supply grid current. The 1k resistor in the grid circuit stabilizes the load on the 6V6. This circuit is good for an 829 or a pair of 4-125A's, and can give linear modulation of the 4-125A's up to 250 ma indicated peaks. Like Fig. 3, it produces controlled carrier.

A clamping modulator which doesn't display the bad characteristics of many such designs is shown in Fig. 5. This one uses a Class A_2 modulator hookup, where the grids of the modulator tube are always positive and draw grid current. This in turn lowers output impedance of the modulator and reduces distortion. (The low output impedance of the cathode follower is the reason why the gating arrangement usually works better.)

With the exception of the unusual grid circuitry, this hookup isn't too different from that of Fig. 1. It is fed by the preamp of Fig. 1 or Fig. 2, and the first half of the 6SN7 amplifies the audio still more. The second half of this tube is a cathode-follower driving the modulator, to give low-impedance drive to the current-drawing grids. The modulator grid arrangement makes the 6V6 in effect into a high-mu triode. Resting current of the modulator is controlled by the 100k pot in the 6SN7 cathode; the less bias this introduces for the 6SN7 grid, the more positive its cathode will be. The 6V6 grids are tied to the 6SN7 cathode, so their bias follows automatically.

The VR tube is used to drop the 6V6 plate voltage to the value needed at the modulated screen. With no audio, the 6V6 plate will be fairly close to the supply level; the VR150 then drops 150 volts from this so that about 125 volts appear across the 22k output resistor. With audio, the 6V6 plate voltage fluctuates with signal. This change is transmitted through the VR tube so that voltage across the 22k resistor ranges from about 5 to about 145 volts. The VR tube must not be allowed to go out during modulation as this would cause extreme distortion.

Fig. 6 shows a high-power version of this circuit, which is capable of handling a pair of 4X250B's at maximum ratings. This gives 200 watts output on 2 meters, rising to 800 or so at modulation peaks. The only essential difference is that the 6SN7 cathode follower is replaced by a 6V6 or 6AQ5, to give more driving power.

If tubes are chosen for either Fig. 5 or Fig.

6 which have non-linear transfer characteristics, and these characteristics are picked to cancel out any non-linearities present in the screen characteristic of the modulated stage, a worthwhile decrease in distortion can be obtained. For instance, 6Y6's can be used in Fig. 6, and results will be considerably cleaner with 4X 250's than if the 6V6 or 6L6 types are employed. Determining just what is best is, in most cases, a trial-and-error proposition since no suitable curves are available.

If simplicity appeals more to you than does near-perfection of audio, the circuit of Fig. 7 should be interesting. It's hard to get much simpler than this.

Input from the mike is amplified by the 6SN7 half, which is direct-coupled to the 6N7 grids. The cathode of the 6N7 goes to the screen of the modulated 6L6, and that's all there is to it. Designer W6MTY used the other half of the 6SN7 as an oscillator to drive the 6L6, getting a complete transmitter with just three tubes. Screen voltage should be set to ½ normal by adjustment of either of the two resistors, though adjustment of the plate resistor is recommended.

Almost equally simple is the "Golden Gate" circuit in Fig. 8. This one also uses a carbon mike, but drives the modulator tube directly with it. Bias on the 12AT7 is set by the 20k pot, which indirectly sets screen voltage and RF power output. The tune-up switch allows CW conditions for tuning. In practice, the rig should be tuned for maximum output in TUNE position, then loading increased until output drops about 15%. Switch to OP and adjust R1 until power output drops to ¼ of the *maximum* read at TUNE. You're on.

For top-quality audio, the circuit of Fig. 9 is recommended by W6SAI. It's a gating circuit, and offers independent adjustment of both carrier-level power output from the modulated stage and of negative-peak level. It's applicable, without change, for the modulation

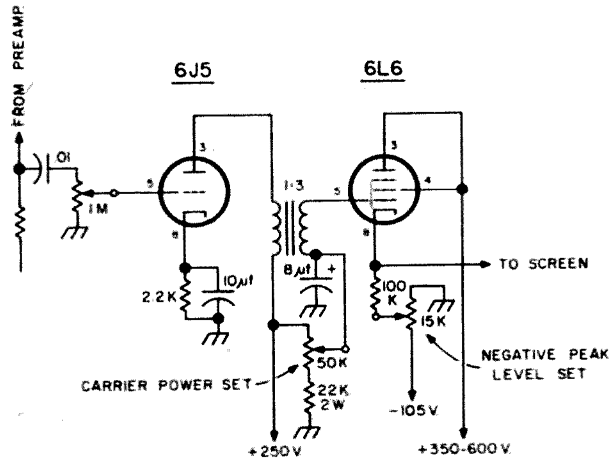


Fig. 9. High quality gating modulator. W6SAI.

of anything from a single 2E26 up to an 813 or a 4-250.

Plate supply of the 6L6 should be about 100 volts greater than normal screen voltage for the modulated tube. Then the 50k pot is set for ½ normal screen voltage and the 15k pot is set at its grounded end. The modulated stage should be connected to a dummy load and a scope hooked up for modulation checking.

Initially, the scope display (if a trapezoid pattern is used) will probably show little negative-peak modulation, as well as extreme flattening of the positive peaks. Loading of the modulated stage should be increased (together with drive, if necessary) until the positive peaks are satisfactory. Then the 15k pot should be moved toward the negative-voltage end until the negative-peak modulation just reaches 95 percent. Apply excessive audio input to see if negative-peak overmodulation is possible; if it is, reduce the setting of the 15k pot.

To hook up a screen-mod transmitter for trapezoid display is something of an art in itself. The connection usually made to the secondary of the modulation transformer can be made to the modulated screen instead; it

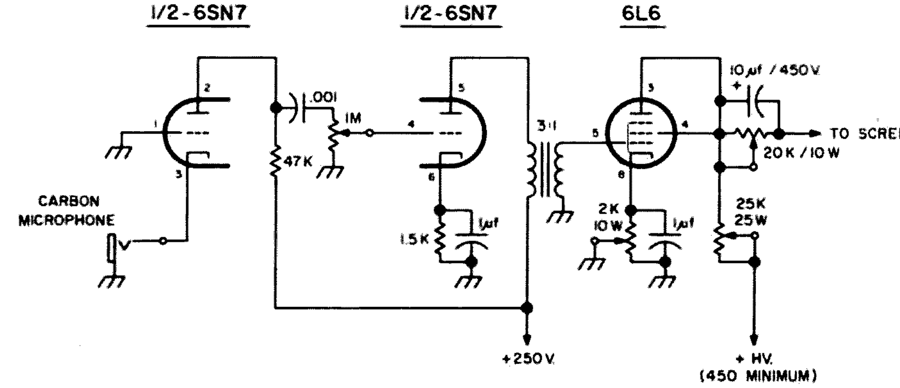


Fig. 10. Clamp tube modulator for 807. W6SAI.

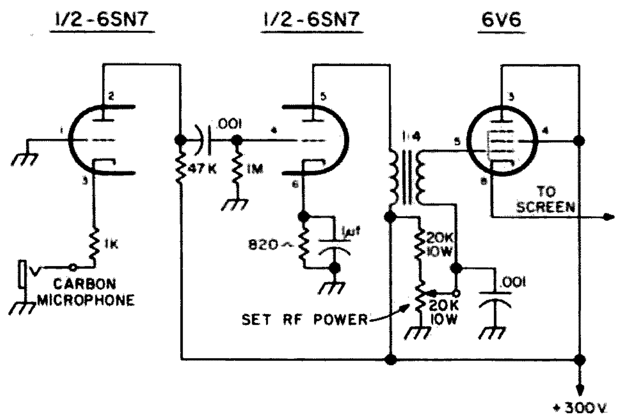


Fig. 11. W6SAI gating modulator for 807.

may require a bit more scope gain to get a good display, but the results will be every bit as good.

If both positive and negative peaks appear satisfactory, but the sides of the trapezoid are kinked, then the resting value of screen voltage is incorrect for the particular tube. Change it in either direction until you get the straightest possible sides, then re-load for best peaks.

Once adjustment is correct, you can lock both potentiometers in place. Note the grid-current reading and the carrier-level plate-current readings of the final stage. Henceforth, adjust drive for exactly the same amount of grid current, and load for the same plate current, and you should have screen-modulation which can't be told from the high-level variety.

Note that the 6L6 cathods is very hot to ground; this means that the filament of this tube should be supplied from an isolated source. This requirement makes this circuit difficult to use in mobile work unless final-stage tubes are chosen which don't require very large screen voltages.

Fig. 10 shows W6SAI's version of the basic circuit also illustrated in Fig. 2. This circuit works nicely with either one or two 807's but isn't so good with 6146's or other low-screen-voltage tubes, and is definitely poor for TV horizontal-output type tubes. Even with 807's, final high voltage must be at least 450 for good results, and 700 to 1000 volts is preferable.

The 25k adjustable resistor should be set to give 250 volts on the 6L6 plate with the final stage tuned to resonance, and the 20K resistor for 130 volts on the final screens. The 2k cathode resistor should be adjusted for 20 volts at the 6L6 cathode. All three adjustments interact and should be checked.

The gating modulator of Fig. 11, using much the same set of components, gives superior results and works with more types of tubes. It is a simplified version of the circuit of Fig. 9, with the negative-voltage supply omitted. Though intended as a constant-carrier circuit, it will produce controlled carrier if the 20k pot is set too close to its ground end.

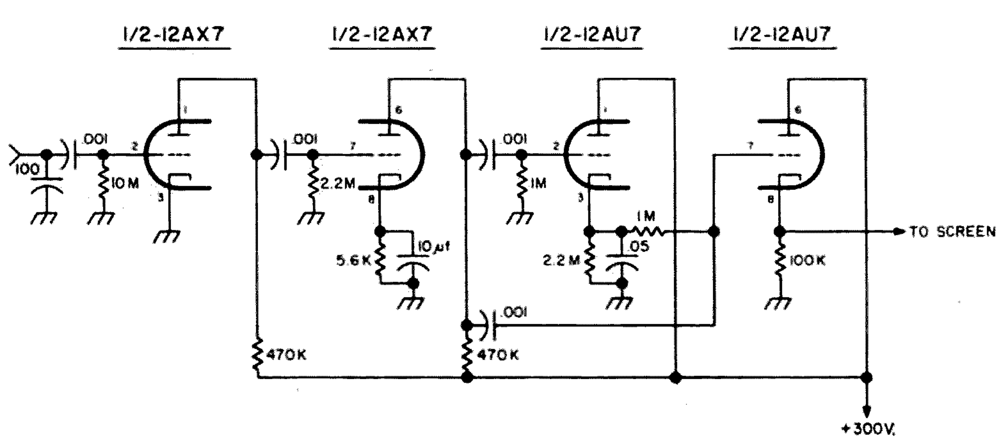
So far, all the gating modulators we've discussed have had to use transformers to get up enough audio swing at the gate tube grids, and the clamping types which give good performance have all used inductors. But in compact equipment, we frequently want to do away with as much iron as possible.

The circuit of Fig. 12 does just that. It's a controlled carrier gating modulator which is highly suitable for a single 6146 and has been used to drive a pair of them, which has no iron at all in it.

This one comes from the Heath people, and was used in the DX-35. Later models used about the same circuit but substituted a 6DE7 for the 12AU7, and on-the-air performance appeared to suffer from the substitution.

The 12AX7 is a preamplifier, and gives us about 150 volts peak-to-peak at its output when driven by a crystal mike and a moderately loud voice. The left-hand half of the 12AU7 is hooked up as an infinite-impedance

Fig. 12. Heath Company transformerless controlled-carrier gating modulator.



detector, because of the high-value resistor in its cathode circuit. The .05 μf capacitor bypasses the individual cycles of audio frequency, but maintains a charge equal to the instantaneous peak voltage of each cycle. The right-hand half of this tube is a straight cathode follower, with its grid returned to the top of the .05 capacitor. Thus the voltage across the 100k cathode output resistor will consist of the 150 volt-peak-to-peak audio signal from the preamp, superimposed on a 0 to 150-volt varying dc level from the detector. This goes to the screen of the 6146; the varying dc level controls the carrier, and the af cycles do the modulation.

Modulation level is between 80 and 90 percent on both positive and negative peaks, and with a 6146 is exceptionally linear if the tube is properly loaded. Unlike the other controlled-carrier circuits described here, this one uses both the positive and the negative half of the audio input cycle, and has a definitely cleaner sound. The only thing about it which identifies it as screen-modulation is the controlled-carrier effect.

When used with a pair of 6146's, or with a 6DE7, however, linearity suffers. It appears that the circuit can only handle enough current for a single tube, and that the 6DE7 requires changes in circuit constants.

Now, after looking over a dozen different designs, you are in a position to pick the ones which fill your own needs best, and if quality is your goal you can get a circuit which will give it to you.

But getting that quality is up to the operator, since as mentioned previously almost every adjustment in a screen-modulated rig is critical. If you're used to tuning up a linear, just think of the screen-mod rig as a different kind of linear and you won't go far wrong. Heavy loading is a must. So is plenty of drive, but excessive drive can also cause troubles. Best procedure here is to start with all the drive your final tube can stand, then reduce it a bit after everything else is set and see if you can improve the scope picture.

In general, the positive-peak modulation will be determined by the loading and drive while the negative-peak conditions will depend on the modulator circuit. Linearity between these peaks will depend on the exact screen voltage of the tube (and may vary from tube to tube in a given type) as well as on the match or lack of one between plate characteristics of the modulating tube and screen characteristics of the final. The adjustment to correct for all of this is the resting-screen-voltage control, sometimes called the carrier-power level-set control. Since so many variables are involved, the only recommendation is to make a change and see if it helps or hurts. If it helps, keep on the same direction. If it hurts, go the other way.

A scope is a necessity for getting top quality out of a screen modulated rig; for that matter, it's just as important with high-level modulation. But with a screen-mod rig, only the scope can tell you which adjustment should be moved. With high-level modulation, you can tell by an educated guess.

The most meaningful scope display is the trapezoid. For this, the vertical plates of the scope should be connected to the transmitter rf output. A handy way of doing this is to take a length of "zip cord," form a two-turn link at one end by splitting the wires and wrapping each back one turn, then twisting them together and taping everything to hold it in place, and connect the other end of the zipcord to the vertical plates of the scope. The link can then be coupled to the final tank and will usually pick up plenty of signal.

The horizontal input to the scope should be taken from the screen of the modulated tube, with the other input lead grounded. Switch the scope to "external sweep" and control the width of the trapezoid with the horizontal gain control.

A perfect display shows up as a triangle. The base of the triangle is the positive modulation peak, while the point is the negative peak. If modulation is less than 100%, the point will be flat. If overmodulating, the point will have a line extending from it. Curved sides on the triangle indicate distortion.

Fortunately, once you have the rig tuned up properly on dummy load it will work the same on any load of the same impedance. This means you can lock all modulation adjustments, note final current readings, and if drive and loading are always adjusted for the same readings, modulation will also remain the same.

If you want to do more reading up on the subject, here are a few references:

Orr, William W6SAI, The Radio Handbook, 16th edition, page 286.

Jones, Frank W6AJF, "Some Experiments with Screen Grid Modulation," CQ, January, 1952 (reprinted in CQ Anthology No. 1, page 127).

Jones, Frank W6AJF, "A New Class A2 Screen Modulator," CQ, April, 1956, page 21.

Orr, William W6SAI, New Mobile Handbook, Cowan Publishing Corp., pages 98 through 103.

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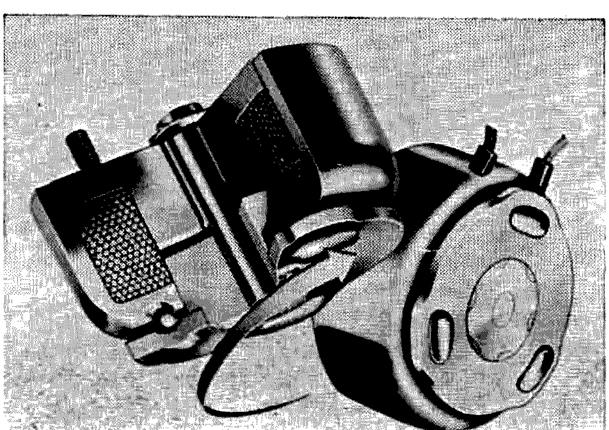
Surplus Remote Switching

In an earlier article,[1] I referred to the use of LEDEX stepping relays as remote switching elements in a complex transmitter switching application. A second article[2] described a surplus, motor driven coaxial switch. Mail received in response to these articles showed widespread interest in such remote switching and positioning devices. Questions were about evenly divided between "How do they work?" and "Where do you buy them on the surplus market?". This article will attempt to answer both questions as related to the rotary solenoid type of remote switches and positioners. The writer is indebted to Ledex Inc. of Dayton, Ohio for much of the information presented herein.

As shown in the exploded view, a rotary solenoid consists of a very short stroke solenoid with the armature supported from the frame by ball bearings which travel in inclined ball races or grooves. When the coil is energized, the armature is drawn into the coil. At the same time, the inclined ball races cause the armature to rotate. By connecting a ratchet mechanism to the armature so that the ratchet is engaged on the forward stroke and disengaged on the return stroke, it is possible to cause the solenoid to rotate a shaft a fixed number of degrees each time the solenoid is energized. Addition of switch sections to the rotary mechanism results in a highly useful stepping switch.

This basic switch still leaves something to be desired from a practical point of view.



Exploded view of a Ledex rotary solenoid.

First, the power source must be manually applied and removed for the switch to advance each position. This handicap may be overcome by adding a separate set of normally closed interrupter or commutating switch contacts to the solenoid. These contacts are connected in series with the solenoid coil and arranged to open as the solenoid approaches the limit of its rotation and remain open until the armature returns to its resting position. When the interrupter contacts close, the cycle repeats and will continue to advance the rotary switch through its detented positions as long as power is applied.

A second addition to the basic stepping mechanism makes it a practical remote switching device. One of the driven rotary switch sections is wired into the control circuit to cause the switch to stop at the desired, remotely selected position. **Fig. 1** shows the circuit of a remote selector switch with all the elements we have discussed. This circuit uses open circuit or "notch" homing to remotely position the switch. If the position of the control switch is changed from that shown, power will be supplied to the stepper switch. The switch will then step through the detented positions until the switch contact through which power is applied rests in the notch of the rotor and power is removed.

The circuit shown in **Fig. 1** is simplified. Rotary solenoid type stepper switches are normally available with 8, 10, 12, 18 or 24 detented positions. If less switch positions than these are required, a mechanism is selected with an even multiple of detented positions and the desired switching pattern repeated for the full revolution of the switch.

Arc suppression circuitry is not shown in the schematic but is essential for good contact life and reliable operation. When the circuit to the solenoid is opened, the magnetic field collapses, generating reverse voltages. While of short duration, these voltages are sufficiently high to damage the contacts in the control

[1] "Surplus Frequency Synthesizer," W4WKM, 73 Magazine, February, 1962.

[2] "A Surplus Motor Driven Coaxial Switch," W4WKM, 73 Magazine, August, 1962.

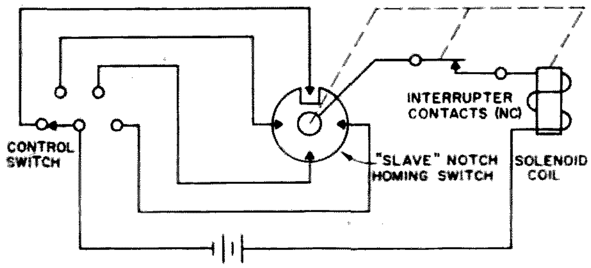


Fig. 1. Basic "open seeking" remote switching.

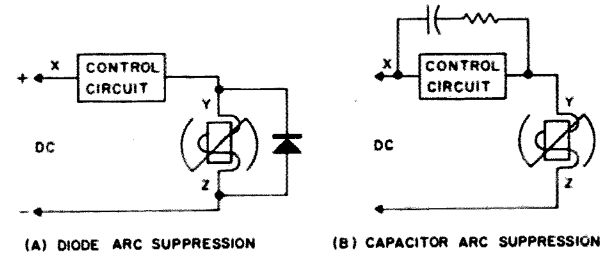


Fig. 2. Arc suppression circuits for use with rotary solenoid stepping switches.

circuit, cause insulation failure and generate radio interference.

Commonly used protection methods are the use of a diode connected across the solenoid winding as shown in **Fig. 2A** or a capacitor connected across the control circuit contacts as shown in **Fig. 2B**. Quite often both techniques are used and this is possibly the safest method. Diode polarity is important and must be as shown in **Fig. 2A**. Suitable diodes are 1N538 or equivalent. When the diode method is used, connect a .05 μf capacitor across the control circuit contacts. Use of the diode reduces the stepping speed of the solenoid approximately 50%. However, this is not too important for amateur applications since the stepping speed will still exceed ten steps per second. The capacitor method of arc suppression, shown in **Fig. 2B**, requires the use of a larger capacitor. Typical value is 0.5 μf at 600 working volt rating. The resistor shown in the drawing is not required with lower voltage units. For units designed for use at between 85 and 100 volts, use the resistor. Five ohms at five watts is a typical value.

Power supply requirements for rotary solenoids are rather critical. These units draw substantial current and a fairly stiff supply is required. Most stepping relays on the surplus market are designed for use with a 28 volt dc power source so this poses power supply problems. A heavy transformer and a full-wave bridge rectifier is almost essential if a conventional supply is used. However, if a slower stepping speed is tolerable, a one ampere transformer feeding a single diode half-wave rectifier may be used with a filter capacitor of 4,000 μf. This circuit will work only if diode arc suppression is used.

Where do you buy these rotary solenoid stepping relays? Well, if you are loaded, you figure out exactly what you need, go to the manufacturer and have him make it up. Of course, this will be a custom design and you will pay a minimum billing charge of $50.00 or so. The next best thing is to pick a stock model (with more contacts than you need) and pay the asking price. Net prices on these units start at around $25.00. Now that we have eliminated 99% of the reading public, we come with the right answer—we buy them on the surplus market. Ray Marver of Ledex says, in response to my query, "Of course, the best deal for a radio amateur is when he is able to locate and design around surplus units offered through distributors."

So here we are, back to surplus. All surplus dealers, at one time or another, have rotary solenoid switches on hand. The unit shown in the photograph was found at Ritco Electronics in Annandale, Virginia and it is typical of the current crop of surplus. However, reference to the current surplus advertisements discloses few offerings. The best bet is to shop around and when you find, buy. If you don't have any luck, there are surplus dealers who specialize in relays. Since they buy stock by manufacturers type, even build up units on order, their prices are a bit higher than what you would pay from the usual surplus dealer. However, it is worth it if you can't find what you need on the open market. Universal Relay Corporation of 42 White Street, New York 13, New York publishes a relay catalog. They carry numerous listings of Ledex, Oak and Price rotary solenoid type stepper relays, solenoids, wafers and power supplies. Prices are very much lower than for manufacturers stock and if you can't find what you need on the open market, give them a try.

This article only skims the surface. However, sufficient information has been given to apply surplus stepper units in your next project. Stick to the simple circuits presented here and try to find surplus units to do the job. There is such a variety of control circuits in general use, each with their own special control and slave switch requirements, that it is impossible in the available space to discuss them all. If you hit a snag, try to find the equipment the surplus unit was used in and then attempt to locate a circuit of the relay control system. While sometimes complex, they all follow a common pattern and you should be able to figure it out. After all, that's half the fun in surplus.

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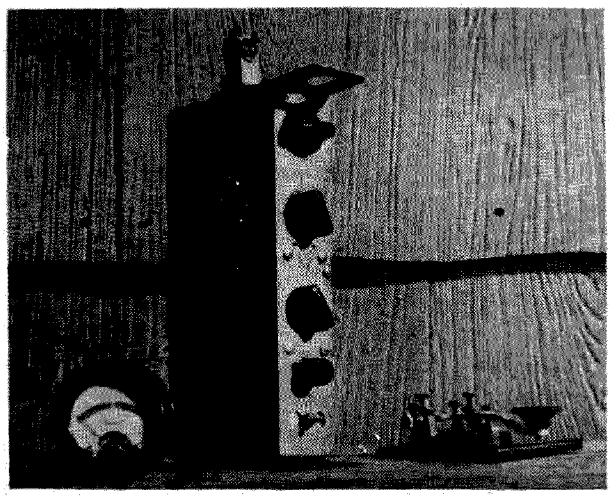
Evolution of a Transistor Transmitter

The everyday use of completely transistorized transmitters seemed to be only an idle dream—a riddle for future engineers and scientists to solve. A transistor transmitter is usually regarded as a very interesting toy and little more. However, the thought sometimes occurs that if the power were a bit higher and a vfo used, such a transmitter would be just the thing for hunting and fishing trips.

A move to an isolated location several miles from town and a mile from a power line yielded excellent receiving conditions. The urge to get on the air grew stronger by the day. Since a transistor receiver was already in use, a small quarter watt transmitter with three transistors was constructed. The hope was that it would work out a few miles under ideal conditions. The isolated location proved to have far better propagation conditions than expected. Six weeks of operation on the 160 and 80 meter bands yielded several states and four QRZ's in a row from a KH6. The conclusion was reached that a vfo was needed.

For the new project, it was decided to try for one watt of power on the 160 and 80 meter bands. With this amount of power the use of inexpensive germanium transistors and flashlight or lantern batteries is practical.



The completed transmitter. Way up top is the switch across the tune up lamp in the supply lead. Controls on front starting at the top: oscillator, drive-doubler and final tuning. The small pointer knob is the band change switch. The meter is from an old tube tester. On 80 meters it reads "doubtful," which may explain the poor report from KL7-land.

Photographs show the arrangement that finally evolved. The BC610 tuning unit at first seemed a sturdy and ideal foundation to build upon. It actually proved to be far from a short cut to a finished product. The "Q" of the coils is lowered by a large amount with the cover in place. The joints in the box are not rf tight. The edges of the box had to be bent out and filed bright to prevent frequency jumping with handling. A more conventional style of construction, with the oscillator in its own shielded box, will save much work. The crude construction is a result of very limited workshop facilities. Most of the work was done outdoors with a kerosene lamp for light and a camp fire to heat the soldering copper. The resulting product, although large and heavy, has proved satisfactory in performance and is still in use with no major changes.

With three transistors in the final amplifier the desired power was obtained on the band of most interest. The vfo problem was much harder to solve. The first attempt at transistorising a Colpitts oscillator was a nerve shattering experience, to say the least. The drift was high and supply voltage critical. When the drift finally stopped, a one volt increase changed the frequency about 2 kc at 2 Mc. The drift started all over again—apparently as bad as the first warm up.

After several months of crystal control, the need for moving about the band seemed important enough to justify another session with the "beast." Since every possibility of taming the Colpitts seemed exhausted, the Hartley was the next confidence breaker. About the same results were obtained. Total shift, drift and creep amounted to about 18 kc. While plotting the frequency and voltage curves of the two oscillators, the discovery was made that the change in frequency was nearly the same amount with either oscillator, but in opposite directions. Clearly, here was the first clue to the cause of our difficulties. The instability was mainly due to changes in the loading of the tuned circuit by the transistor,

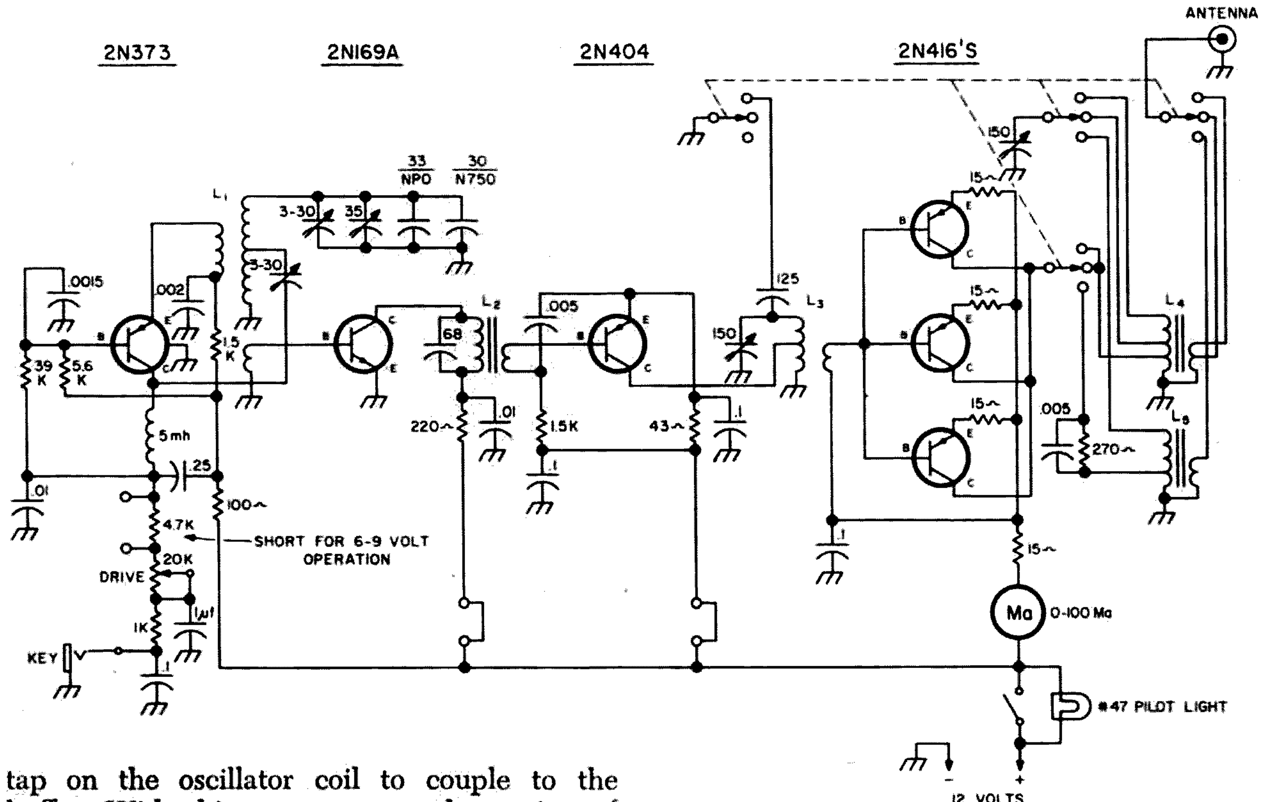
not by changes in capacity as first assumed.

After a quick refresher course in oscillators from Terman's Radio Engineers Handbook, several oscillators were tried which used a combination of capacitive and inductive coupling to the tuned circuit. The one presented here seemed to be the easiest to construct and adjust. The coupling trimmer allows compensation for wide variations in coil construction, circuit loading and transistor gain. The drift problem was all but eliminated by using a drift transistor. The final result is a stable oscillator that can be keyed with no audible chirp, and the drift is just a few cycles.

General Circuit Description

The oscillator of the transmitter tunes from about 1745 to 2005 kc. Inductive coupling is used for coupling the tank to the emitter of the oscillator transistor and the base of the buffer. Changes of temperature or current to these two transistors will change the input resistance to a large degree. Rf power is supplied to the tank circuit through an adjustable trimmer capacity. With proper adjustment, the change in frequency of the oscillator tank caused by the variation of the load on the inductive coupling loops, is cancelled by the current lead through the capacitative reactance of the trimmer between the collector and tank coil. This system compensates for a multitude of effects that plague a solid state oscillator. Without it, voltage regulation of the collector, bias stabilization by means of a thermistor or similar device, and rather complete isolation of the oscillator from the following stage would be necessary. This would complicate the system greatly and still leave the keying problem for later in the chain between the oscillator and antenna. Even then, the inherent low frequency rumble in current of most transistors would cause a random quiver in the note that resembles a slight case of aurora propagation on the VHF frequencies. The dc operating point of the oscillator transistor is set by means of voltage divider base bias and emittor resistor.

The buffer is loosely coupled to the oscillator tank and is operated without forward bias. Operated in this manner, nearly one tenth of a volt of drive is needed to start current flow in the collector circuit. By using this effect, differential keying is accomplished without complications of relays or extra parts. The output of the buffer is heavily loaded by the following stage, and is fixed tuned. It was during the testing of these first two stages that the old stability problem loomed large and threateningly again. The first design used a



COIL DATA

L1. 85 turns 5-44 litz. D 5/8, L 5/8. Tap 27 turns. Emitter coil, 2 turns over ground end wound same direction. Coupling coil, 2 turns near ground end. Exact position determined by tests.

L2. 100 microhenry rfc or video peaking coil. Secondary is about 30 turns of 30 wire wound over main winding.

L3. 55 turns #32 tap 15 turns from ground. Secondary is 5 turns small plastic hook up wire, over ground end.

L4. 120 turns #30, tap 80 turns up. Collector tap is 8 turns from ground. Output link is 8 turns tapped at 6. See Text for alternate output coils for 50 ohms. Form is surplus 3/8 diameter with 7/8 winding space. All the turns won't fit in one layer so it was semi-scramble wound.

L5. is on a Miller 4400 form 3/8 d. 18 turns #26 tapped 5 turns from ground. Output coil is 2 turns.

tap on the oscillator coil to couple to the buffer. With this arrangement, the tuning of later stages of the transmitter pulled the frequency a matter of a kilocycle or two. Improper tuning produced a beautiful chirp. Careful inspection of the diagram at this point showed that proper decoupling would be difficult to obtain. A change to inductive coupling with the return of the secondary to a common point for each stage was completely effective in regaining stability. The lesson here is: transistors are low impedance devices, and ground loops are to be avoided. Stray capacitances are not as objectional as in tube type circuits. Both the oscillator and buffer were crowded into one small compartment with no bad effect as long as the returns were handled in the proper manner.

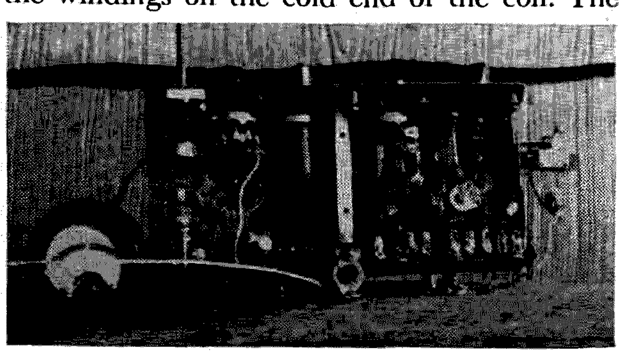
The driver stage operates either on the oscillator frequency or doubles to cover the 80 meter band. When used as a doubler this stage delivers somewhat less than optimum drive to the final amplifier. The band switch available did not allow separate coils for each band, so compromises were necessary. Drive is such that the desired one watt to the final is available on 160 meters and about .6 on 80. Resistors in the emitter and base circuits supply several times cut off bias in a manner similar to conventional tube type circuits. Drive to this stage is held down to a point that limits the out of tune current to a little over ten ma. This is done in order to use only one metered circuit and not have a minor disaster during tune up procedure.

In the final amplifier, considerable work was done to establish the number of transistors and class of operation for the power desired. During these tests, up to four transistors operated in class C were pushed to two and a half watts input. Under these conditions, neutralization is very desirable. Both reactive and resistive components of the transistors must be balanced out under full load and drive. As an added precaution, the final must not be operated under full drive and no load. Tank circuit considerations are very stringent in regards to loaded "Q" and leakage reactance. Since the main limitation of these transistors is the peak current rating of 200 ma each—a never evceed sort of a thing—not even for a microsecond, the three that I have left are operated substantially class "B."

The efficiency is somewhat lower with the peak current rating rather than transistor dissipation still being the limiting factor. Overall efficiency of the transmitter doesn't suffer much due to the smaller drive requirements. A reasonable input seems to be about 300 milliwatts per transistor. At this power level the collector current shows no tendency to creep during key down conditions. When several transistors are used in one stage there is a problem of getting the power divided evenly between transistors. The use of unbypassed emittor resistors of ten to fifteen ohms each did much to stabilize this stage and divide power evenly without careful selection of transistors. Collector current can be loaded to about 90 ma at 12 volts.

The low impedance made conventional tank provided one interesting effect not encoun-circuits almost unusable. The pi network provided one interesting effect not encountered before. Every strong signal from 3 Mc and lower was fed back into the collector circuit where they mixed with a radio range station signal from about 15 miles away. This mess radiated to the receiver and filled the dial with a strange mixture of voice, music, RTTY, code and other sounds that defy description. For this reason inductive coupling was used between the tank and antenna. In order to obtain a reasonable ratio of loaded to unloaded "Q" a practice resorted to in receiver coils was used. The collectors were coupled to a low "C" tank by means of a tap on the coil in order to provide a large step-up in voltage. This provides proper flywheel effect with components of reasonable size.

At this point it was discovered that an iron or ferrite core was a necessary part of the scheme. Contrary to the usual practice with slug tuned coils, the slug should be well into the windings on the cold end of the coil. The



The inside story. The large compartment is where the final amplifier is kept. In the middle is the driver which for a time seemed destined for a life as a crystal oscillator. To the right is the vfo and buffer. Now you can see why the oscillator and buffer stages should be built as a completely shielded subassembly.

low impedance windings of the tank should be right over the bottom of the tuned winding centering over the slug. The slug is used as a means of increasing coupling and decreasing leakage reactance, not as an adjustment aid. The turns on the coils should be adjusted to obtain the required inductance with the slug in its correct position. With this method of construction the tuning is conventional in every way with the point of maximum output and minimum collector current occurring at very nearly the same spot on the dial. Since a three position band switch was used, a 40 meter coil was added as an afterthought. The bias on the final is too low for effective doubling so the efficiency is very low. The power input to the final is held within the dissipation rating of the final transistors by means of a bypassed dropping resistor in the lead to the collector tap on the 40 meter coil. About 80 milliwatts output was obtained. This will heat the filament of a two volt 60 ma bulb to a visable temperature on a dark day. When used by itself this puts the transmitter in the toy class again. This power will excite an amplifier of some size though. It has been used to drive a bank of six type 2N404 transistors to one watt input. As a test it drove a TV sweep tube, 6CD6G, to 75 watts.

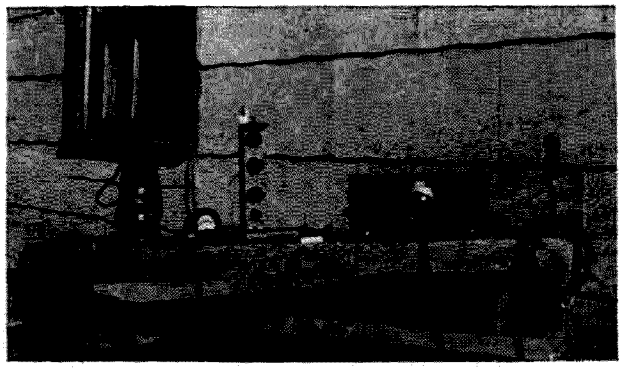
After construction comes adjustment. For this use a six volt supply and in the preliminary checking always use the tuneup bulb in series with this supply. Temporarily short out the 4700 ohm oscillator dropping resistor. Set the drive control to deliver about four volts to the oscillator. Use a meter of about ten ma full scale to read buffer current. Use no voltage on the driver or final at this point. Find the signal and adjust the trimmer to be sure the oscillator will cover the range of 1750 to 2000 kc. Adjust the position of the two turn buffer coupling coil for about one ma of collector current. Now lower the voltage with the drive control and notice which way the frequency changes. If the frequency goes lower as the voltage decreases, the coupling trimmer is too small in capacity. Try again with a slightly higher capacity setting. If the adjustment is made at a frequency of about 1850 kc, the adjustment will probably hold over the entire frequency range. It should be possible to vary the voltage from two and a half volts to almost six volts and stay within zero beat with the receiver. As the signal starts to shift at low voltages, the drive to the buffer should be low enough to cause very low collector current. The adjustments of the coupling trimmer and buffer coupling coil interact to some extent so it will be necessary to go

back over them a few times to get best stability and the differential keying effect simultaneously.

The compensation tends to be nearly perfect at two points on the dial. If the compensation is done near 2000 kc, the stability gets rogressively worse as the frequency is lowered. When the compensation is done at one f the cross-over points, the compensation will be excellent over most of the dial. At the oint of best compensation, the stability in egards to voltage changes is somewhat better han a crystal oscillator.

At this point the driver should be supplied ith power through a meter. With increasing drive, the collector current should reach a aximum of seven or eight ma. With no voltge on the final, the loading will be very heavy, so the resonance dip may be very light. At this point in the adjustment procedure, the final touch up of the two oscillator djustments can be done. The differential keying should be very evident and maximum drive should not cause over about eight ma collector current regardless of frequency. Now pply voltage to the final. Still using the tunep bulb, the off resonance current to the nal should be about thirty ma on the 160 eter band, with twenty-five ma or so on the 0 meter band. At this point, the coupling coil n the driver tank can be adjusted for most rive on 80 meters. With the final tank output oils specified, the transmitter will load into 170 foot antenna by using a series tuned ircuit in the antenna lead for reactance canelation and harmonic suppression. If a 50 hm output is needed, some change in turns ill be required.

By using a six volt supply and a 60 ma volt bulb for a dummy antenna, the turns an be adjusted for heavy loading and full rilliance of the bulb. When the transmitter is sed on 12 volts it will approximately match 50 ohm load. With the adjustment procedure iven here, the transmitter can be used with ny supply voltage from 6 through 12 by horting the 4700 ohm resistor for 6 through 9 volt operation. During operation of the ransmitter, use just enough drive to secure eak output for the loading used. Excess drive tends to spoil the differential keying ffect and causes unnecessary demands on he driver and final transistors. During procedures involving band changes and large requency changes in a given band, the use of the tune up bulb in the supply lead will give some measure of protection. Due to the ow thermal inertia of the small transistors, ut of resonance operation should be avoided.



Here are some of the essentials of the station. From left to right; kerosene lamp, meter, transmitter, receiver and key. The device with the wood handle is not commonly available from the usual radio supply store. It was obtained on special order from the local hardware store. By asking the white-haired gentleman first, considerable explanation and some time can be saved.

Out of resonance current is probably in excess of 125 ma.

During normal operation the currents to the various stages are approximately as follows: Oscillator: one ma or less. Buffer: two ma or less. The driver current will be about six ma on 160 with nearly ten ma when doubling. The final can be loaded safely to 90 ma on 160 with about 60 to be expected on 80 meters. These values are for normal 12 volt operation. For six volts the oscillator current will still be near one ma with the other currents a bit less than half the 12 volt values.

During the breadboard stage of development, many different types of transistors were tried in all stages. For oscillator use, all the drift types tried seemed to perform about the same. The use of ordinary high frequency alloy junction transistors in applications such as this did not prove to be acceptable due to the changes in capacitance between collector and base during changes of voltage, current and temperature. With normal collector voltage this capacitance will be in the neighborhood of 10 to 30 pf. However, with very low voltage, this capacitance will be very much higher, perhaps as much as 100 pf. The drift type has very low capacitance to begin with, apparently 2 pf or less. In the drift transistor, the base to emittor capacitance is less than 300 pf as compared to nearly 2000 pf that some alloy junction types will have. With the smaller and perhaps more stable capacitances of the drift transistor, the capacitance effects can almost be ignored, leaving only the resistive effects to be reckoned with. In the buffer the same considerations apply to a lesser extent. Here either the drift or grown junction types were satisfactory. The alloy junction types used here caused some drift and loss of isolation from effects of later stages.

In the driver and final stages, the alloy junction types come into their own. With their rather large internal structure, the peak current capabilities exceed the drift and grown junction types by a factor of ten or twenty. The low load impedances that can reach values under one hundred ohms make their large capacitances insignificant during normal operation. With no collector voltage the capacitances will be high enough to be misleading if a grid dip meter is used to check the coils. If such a method is to be used, the transistors should be disconnected temporarily.

Results with this transmitter were far better than might be expected from its modest power. During winter months it was common to hold hour long rag chews with stations several states away with only an occasional repeat needed. During the summer months, just after dark, operation was generally successful, but later in the evening towards midnight, the static caused trouble about half the time. Just before dawn, when static levels drop sharply, contacts at a distance of 1500 miles were not unusual. Best DX on 160 meters was a KH6, while on 80 a KL7 was agitated until he finally got my call letters straight. On 40 meters the results 'barefoot' were generally poor, due to the very limited power output. One contact at a distance of 800 miles was solid for an hour. Several reports were received at greater distances, but a solid contact was a rarity.

Two types of antennas were used with this transmitter. The old faithful half wave worked out to about a hundred miles with a good signal. The most interesting antenna was an inverted L marconi with a hundred foot flat top and a sixty foot down lead. This is the antenna that did the best by far. At 500 miles it was about four S units louder and much less plagued by deep fades. In the late afternoon this antenna was usable a full hour before the half wave and stayed in for almost two hours later in the morning. During daylight hours this antenna was usable for over 60 miles while the half wave was of no use whatever. The inverted L uses a three wire counterpoise with each wire about a hundred feet long. Several different arrangements of the counterpoise were tested with no big difference as long as they were under the flat top. Comparison of the counterpoise with a ground rod driven six feet into the ground could not be made, because with just the ground, no one answered my calls.

. . . W6WFH

Richard Factor WA2IKL
115 Central Park West
New York 23, New York

Standard Frequencies

Most hams are familiar with the process of deriving 10kc marker signals from their 100kc standard by means of locking a multivibrator on 10kc using the 100kc signal for synchronization. From time to time, other standard frequencies are required in the shack, either for the alignment of filters or for calibration points on test oscillators. This same principal can be used to obtain even divisions of 10kc (10kc, 5kc, 3.3kc, 2.5kc, etc.). Instead of building another multivibrator to accomplish this, simply connect the output of the 10kc multivibrator to the vertical plates of your oscilloscope, adjust the sweep oscillator until the number of complete cycles on the screen corresponds to the number of times you want to divide the original signal, turn up the sync until the pattern locks, and your sweep oscillator is oscillating on a very accurate submultiple of 10kc. A binding post on the front panel of your scope should take care of your output requirements. If you are a member of a two-scope-family, you can get literally hundreds of calibration points throughout the audio range. If you have good scopes, you can use the sweeps to divide your 100kc and even 1 mc standards.

Because of the (hopefully) high harmonic content of both the multivibrator and sweep oscillator, it might be advantageous to include a simple filter in the output. It need be nothing more than a resistor in series with the output and a capacitor with fairly high reactance at the operating frequency but low reactance at its higher harmonics connected to ground after the resistor. This will be unnecessary in most cases.

Other audio frequencies available around the shack are 60 cycles from the ac line, 120 cycles from the output of any full wave supply, 440 and 600 cycles from WWV, 1000 cycles from the telephone company (dial local exchange and 9945), and if you have a good tape recorder, you can double or half any of the above without resort to the scope.

. . . WA2IKL

Howard Pyle, "YB" W7OE
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Mercer Island, Wash.

Build—

or Buy?

I suppose that as long as we have hams, this will be a controversial subject; it has been for as long as I can remember. Pioneer hams back in the dear, dark ages did more building than buying. In most cases they had to . . . available factory-built equipment was spread pretty thin. Sure, you could purchase a spark coil, a slide tuner and later even a loose-coupler . . . telegraph keys were relatively plentiful but aside from a few items like this, the choice was either to build it yourself or give up the hobby.

Now? There is such a myriad of transmitters, receivers, antennas and various accessory equipment offered on the open market that it leaves one completely bewildered! Ninety per cent or more of these offerings are darned good pieces of merchandise; like anything else, the greater the strain that your wallet will bear, the more elaboate gear you can come up with. But . . . where's the fun? Creativity is a most important asset to the American way of life. The great sense of satisfaction in building a boat . . . restoring an ancient automobile . . . using your skill to design and construct a new set of bookshelves for your living room or den all provide a thrill

An example of home constructoin on a kitchen table. This item is shown ninety percent complete needing only soldering the loose wires shown to their final terminals.

that you'll never get from simply plugging in a few wires and cables, tossing a random length of wire over a conveniently located tree limb and calling yourself a ham. You're *not*; really!

Juvenile, youthful and adult Americans, both male and female, welcome a challenge to their skills, initiative and ingenuity. Ham radio construction from scratch is a perfect provider. To design a circuit or perhaps use someone else's published design either with or without modifications to suit your taste, puts you right on your own, construction-wise. And, while you are improving your craftsmanship through the actual physical building of a piece of ham gear, you are also increasing your knowledge of basic circuitry, radio theory and construction techniques. There is no thrill to equal that of having actually built a piece of equipment which goes right to work when you put it on the air. Maybe a few bugs to work out first, but each one of these teaches you something which will prove of increasing value to you throughout your entire ham career.

Frequently the question is asked, particularly by the young "Eager Beaver" group, anxious to get on the air at the first possible moment, "Why do I have to drill all those holes, cut and bend sheet metal and all that slow and tiresome work when I can buy a kit with all of the hard work done?". It's a fair question and can be fairly answered. The apartment dweller, for example, with no shop facilities available, is probably confined to a few evenings and week-ends when he is, perhaps, privileged to use the kitchen table for a work bench (if he cleans up afterward!). By reason of noise-conscious neighbors on the opposite sides of the "cardboard walls", a hammer, electric drill and similar noise-mak-

ers are taboo. For such aspiring hams, the factory offered kits are a boom. Placing screws in pre-drilled holes, tightening nuts with a socket wrench and soldering wires to terminal points are all silent operations; no neighborhood complaints. And the time element in kit assembly is ordinarily much less than in building from scratch.

Maybe you're a busy executive who, of necessity, brings home a briefcase full of papers to work on in the evening. Little time for physical construction activity, yet you want to pursue ham radio as a hobby and relaxation. Either a kit or, at some increase in cost, a complete factory-wired set of equipment, will give you many pleasure filled hours on the air. You are, nevertheless, sacrificing the indescribable joy of creation. Should you be fortunate enough to occupy a home with perhaps a basement, or a shop at one end of your garage, the opportunity to enjoy the full measure of ham radio construction and operation can be yours. A modest collection of simple tools, embracing a hand or electric drill, a bench vise, light hammer, diagonal and long nose pliers and a few screwdrivers together with a soldering gun or iron will just about cover the essentials for the less elaborate items of ham construction. Expand your shop facilities and add to your tool collection from time to time as you can. Many labor saving devices such as socket punches, a "nibbling" tool, an electric rather than a hand drill, are all readily available and at moderate cost. The catalogs of all of the major electronic mail-order supply houses list many tools as well as electronic parts . . . your choice is wide.

Your local supply house, if you happen to live in an area which supports such, also carries most of these items in stock for over-the-counter delivery.

Ham radio construction isn't hard. You're not a plumber crawling on the damp ground under buildings and fitting heavy pipe. You are not an electrician groping through dark and musty attics, drilling holes and dragging wires. You can ordinarily work in warm, pleasant and comfortable surroundings and do most of your electronic work from an ordinary chair or a kitchen stool. A large part of the work represented in the accompanying photographs was accomplished in just that way. The tremendous sense of satisfaction and accomplishment to the builder after satisfactory completion of such projects, was a many-fold return. Next time you want a piece of electronic gear, try *building* it . . . it's really fun!

. . . W7OF

VHF

Project OSCAR

The reduction of OSCAR III flight data is now underway. Temperature data during the first thousand orbits is especially desired. With the satellite now well into its second thousand orbits, the 145.850 mc beacon continues to operate intermittently. Project OSCAR believes the operation of the beacon will become more consistent when the earth shades the satellite from the sun and the internal temperature drops. (OSCAR has been traveling in full sunlight.)

Reliable reports indicate the 145.950 mc beacon IS operating, but some 20 db down in signal strength from the expected level. Reports on this beacon are solicited.

OSCAR IV??? It is hoped the data and information received from the OSCAR III flight will assist in the launch of an improved 2 meter OSCAR IV repeater satellite during the latter months of this year.

If you have not already done so, please send your report on OSCAR III to: Project OSCAR, Foothill College, Los Altos Hills, California.

Project OSCAR appreciates the reports received and if you have not received a reply to a specific question regarding the program, it is because they do not have the staff to handle all the mail and are busy processing data.

West Coast Antenna Contest

W6AJF's 432 megacycle expanded-extended colinear has again won the annual west coast antenna measuring contest.

Loren Parks tells me this year's contest turned up two commercial 432 yagis that showed an actual LOSS in "gain" over a reference dipole.

This yearly contest is becoming more and more popular and is surely disproving gain claims made by some manufacturers on their 432 mc antennas.

Loren will have the full results of the contest in "VHF'er Magazine" which he publishes. If you haven't seen a copy of the "VHF'er", drop Loren a card at VHF'er Magazine; Route 2; Box 35; Beaverton, Oregon. Subscriptions are $2 per year and worth more.

Circular Polarization

A couple of months ago I said I was running some tests on circular polarized yagis and that the results would soon appear in this column.

Well, I've learned not to plan too far ahead. The Gain "Moonbouncer" is in operation and living up to the claims made for it. There have been no meteor showers at the time of this writing to test it on and I want to before going any farther.

Some of the experts say there is a 3 db loss between circular and linear polarization. I have not noticed this and doubt that I will. If there is such a loss I do not believe the average "S" meter or ear will detect it.

On tropo and groundwave paths and "Moonbouncer" is delivering the "goods" with a suggestion of QSB reduction with the circular polarization.

Coax Losses

Joe Burnett, K2SBV/7, has sent me a list of 81 different coaxial cables and their characteristics. Some of these cables are uncommon and information on them is difficult to obtain. If you want a copy, send me a stamped, self-addressed envelope and I'll get one to you.

SK

This past month has brought a large increase in the mail regarding this column. A healthy sign the column is starting to take hold. My thanks to those who have written the compliments, suggestions and criticisms. The criticisms have been well taken and I appreciate having the mistakes pointed out. Keep the letters, etc. coming and the column will continue to grow.

. . . **KØCER**

Letters

advised by my lawyers that
don't you ever proofread y
have no other recourse but
should be tarred and feath

Dear Wayne:

Please print a thoroughgoing resumé of the ARRL Convention at San Jose, including a lucid, simple explanation why it was held in San Jose in the first place; after all, San Francisco has topless waitresses and San Jose has nothin'! What I really would like is to know what happened, because I tried to make it, honest-to-gosh I did—even bought a ticket, but couldn't hack it.

This is what happened:

I received a flyer explaining the conveniton was to be held in San Jose this year, that there would be a helluva program, and furthermore I could Advance Register for the trifling sum of $9.50 US. This didn't seem like too hard a bite, so I sent the $9.50 along—my XYL likes to go to the more interesting soirees with me, such as Union Socials, Teachers Meetings and the like, but when I asked if she would like to take this one in she just gave me a pitying look. I wondered why at the time, but since have come to the conclusion that she must have been born with a caul.

Inasmuch as the convention was slated for the Fourth-of-July weekend, I knocked the crew off for Sunday and Monday, and after work Saturday fought the traffic down to San Jose.

Not only did I have bright hopes of the good-fellowship and companionship of a bunch of dedicated hams, but there was the added impetus that *CQ Magazine* might have a booth there, which would give me the opportunity to inquire, in a loud and demanding tone of voice, why the hell I haven't been paid for an article of mine they published some three or four years back.

Anyhoo, I gets down to San Jose and tracks the convention to the Municipal Auditorium. At least I think I did, because at about 5 PM I couldn't find anything of the registration committee except a sign telling where the line formed for registration. Not a bloody soul in sight, s'help me!

I corralled a couple people who were wearing badges, though, and asked them how I would go about getting registered and getting my blue badge too, and also if *CQ Magazine* had an exhibit.

The first party I asked told me that I would have to go around to the other side of the Municipal Auditorium and come through the parking lot and then I could register, and the second ham-type in all seriousness (*could* he have been putting me on?) told me *CQ Magazine* was running the show.

I strongly suspected the latter piece of information at first sight, and I began to question the validity of my directions for registering when I hiked around the building and found that the untrusting souls had locked the doors on the other side, too.

Some good heart then informed me very kindly that I should go over to the hotel kitty-corner across the way, because that was where the action is.

I have seen more action at the Pioneers Home in Sitka, Alaska on a week-day evening after supper.

I wandered around holding my nine-and-a-half postcard and asking all the sundry what to do to get registered, including various people wearing ribbons indicating they were officially connected with the clambake. Nobody knew nothin'.

One ham from Sacramento, though, did agree that it was generally run at about the same level as a Field Day, and regaled me with a sad tale of the ham who poured the five-gallon can of lube oil in the gas tank of the putt-putt. . . .

Up on the second floor was a ladies hospitality room where a tired broad could get the weight off her corns and have a cuppa coffee, but inasmuch as I was disqualified by the possession of the wrong kind of plumbing, I was not allowed even this kindness.

Another ham did let me look through his program—keeping a firm, tight grip on it all the time—and there were several features that looked promising.

After about an hour's waste of time I was fortunate in ıeeting a YL from KL7 who told me how to reach a dinner ıeeting that was about to start. This looked like a fine deal ut somehow it didn't look so good when I found that it 'as necessary to register well in advance or no grub.

All was not lost. I had the good fortune to be able to say Hi" to two very fine KL7's, Jack and Marge Reich, :L7AUF and KL7BLL.

Since I didn't have the ghost of a chance of getting anyhing to eat at this particular spread and remembering that an Francisco is famous for its good restaurants, and San Jose ; famous for being the home of the Roscrucians (sic), I did he obvious thing and hied myself up 101.

But first, or rather, last, I politely handed my nine-dollar ard to a young man with a "Host Committee" ribbon.

He looked at it blankly and asked, "What do I do with his?"

"Now you got me, Brother," I replied. "I haven't found ınything to do with it either, and any suggestions I vould make would probably lead to fisticuffs."

When I got to San Francisco I called the crew while the ;callopini was working and told them the boss had recovered 'rom his temporary aberation and that all hands would come o work mañana por la mañana.

The XYL is still giving me the "I-knew-better-but-I-didn't-want-to-say-anything" look, and I think she is right.

Funny, but she had a heck of a fine time at the Photographic Society of America Convention.

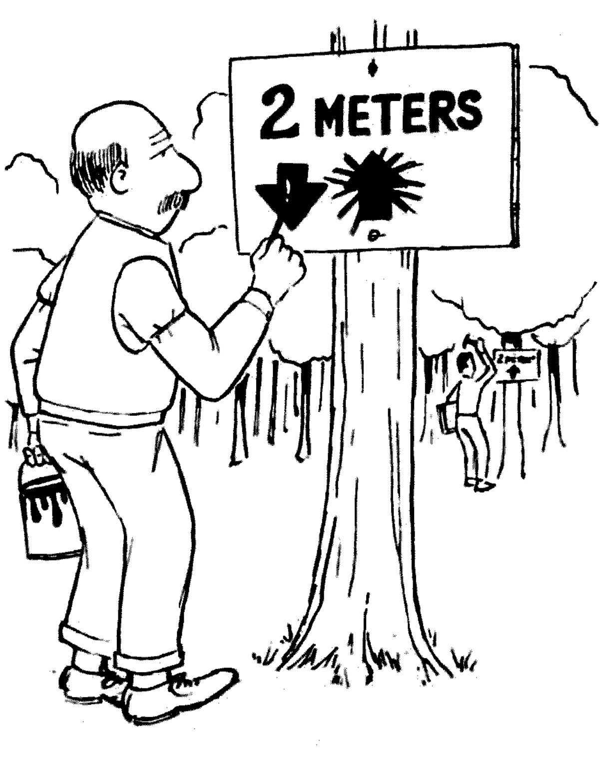
But of course it was held in a town chock-fulla good restaurants (San Francisco. where else?) and was not operated like a cross between a PTA meeting and a Box Social.

Terry Murray, WB6AKO, ex KH6DXG, etc.

Hartland Smith W8VVC
467 Park Avenue
Birmingham, Michigan

Let's Go—Up or Down

Old timers often speak of it as going DOWN on 2 meters. The newer crop of hams are more apt to talk about going UP to 144 mc. However, whether you're an ancient two letter brass pounder or a bright eyed box top Technician, you should seriously consider putting some sort of rig on the 2 meter band.



Until a short while ago, my high frequency experience consisted merely of a short stint on 2½ meters with a long lines oscillator and a superregen receiver back in 1945, plus a few 420 mc QSO's provided by a surplus BC-645. Then, last winter, Oscar took off. K8EGD loaned me his 144 mc converter just long enough to give me a chance to tape record the pioneer ham satellite on a couple of its early passes. While waiting for Oscar's high speed "HI's" to come squeaking through the speaker, I did a bit of tuning from 144 to 148 mc and was pleasantly surprised to discover how many stations were making use of this band. I decided then and there to get my feet wet on 2 meters.

In the belief that habitués of the dc bands may be interested to learn what's really transpiring in "never-never-land", I'm setting forth a few of my experiences in the paragraphs which follow.

Being a dyed-in-the-wool home constructor, I hurriedly put together a Nuvistor converter, one consisting of a pair of 6CW4's in cascode and a 6CW4 mixer. Crystal oscillation and multiplication is accomplished with a 6U8A. The output of this gadget is then fed into the special 30-35 mc tunable *if* range of my NC-300.

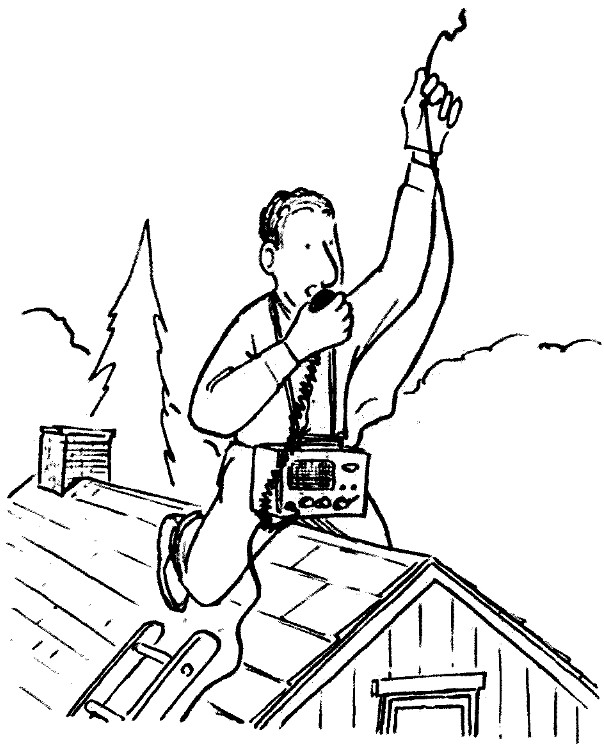
For a transmitter I threw together a 20 watt :E26 rig. And when I say "threw together" mean it quite literally. Parts were scrounged rom the deepest corners of the junk box in n effort to keep the cost at a bare mininum. The result may not be a work of art, the fficiency may only be 20 or 25%, but by golly 'm having loads of fun working the local boys, s well as stations in Ohio, New York and Canada, on the 2 meter band.

Most hams seem to hold the widespread nisconception that kilowatt transmitters, hunlred foot towers and 64 element arrays are equired to produce 144 mc QSO's beyond he horizon. Nothing could be further from he truth. As a matter of fact, almost no power t all is required for consistently good QSO's ut to 30 miles or so. Take the Heath Twoer, or example. The transmitter section of this omplete 2 meter station struggles valiantly to ut out enough rf to light a single pilot bulb. And yet, there is a fellow whose QTH is at east 15 miles from mine who consistently puts n a 10 over 9 signal with his Twoer driving small beam. I recently contacted a VE3 at nore than 20 miles who was using an indoor ntenna hooked to his Twoer. His signal vas around S-7. He told me that when the and was open, he easily worked New York tate, a distance of more than two hundred niles!

What kind of antennas to the boys have? Vell, almost everyone utilizes a factory built adiator of some sort. Five to ten element Yagis predominate. Consequently, when I first got on the air and employed a folded dipole ed with ordinary TV twinlead, I felt somevhat out of step. The dipole was perched top my 10-15-20 meter beam at a height of bout 42 feet and could be rotated for optinum directivity. Even this simple antenna lid quite well for me. With it, I had no lifficulty working into Goderich, Ontario, well ver a hundred miles away. Right now I have home-brew eight element Yagi with a half nch aluminum boom and hard drawn aluminum clothesline wire for elements. Its weight s practically nil and it causes almost no added train on my low band beam installation.

While it is true that every foot of antenna eight means that much better ground wave overage on the VHF bands, you'd be surprised at the results achieved with chimney nounted beams. 30 to 50 mile contacts are ommonplace. And when the band is open, he height above terra efirma seems relatively inimportant.

Take my QTH, for instance. I'm situated on he north side of a small hill. Unfortunately,



most 2 meters activity is to the south. Consequently, even though my beam is 42 feet above the back yard, I am forced to shoot through, rather than over, the houses and buildings which tower above my radiator. Despite this handicap I manage to snag plenty of fellows with S-9 plus signals at or beyond the 30 mile mark. When the band is open for extended ground wave or skip I'm able to work most of the distant stations I can hear.

What about receivers? Well, the majority of fellows tack a commercially built converter ahead of their low frequency ham-band sets. Now that Nuvistors are commonplace and inexpensive it is no longer necessary to spend hours and hours building and adjusting an exotic and costly converter in order to hear weak 2 meter signals. A few of the real pros are still struggling for that last db with a 417A, but most of the general run of 2 meter boys are content to sit back and let the tiny 6CW4 do the work of dragging 'em in.

Except when utilizing the receiving portion of a Twoer, very few 144 mc men still rely on the "broad as a barn door" super-regen circuit. Twoer operators, by the way, are the only ones who ever seem to complain about QRM. 2 meters is so tremendously large (it has more space than all ham bands from 160 through 10 meters, combined) that just about any type of superhet will give more than adequate selectivity. During my nine months on the band only a very few QSO's have been even mildly QRM'ed!

This lack of interference can hardly b blamed on inactivity. True, the band is usuall deader'n a smelt during the daylight hour on weekdays, except at lunch time and whe the commuters are mobiling. However, b 2300 GMT, at least here in the Detroit area a person is almost certain to get a contact i he's willing to try one, or possibly two, CQ's As a matter of fact, it is much easier to ob tain an evening QSO on 2 than it is on 10 me ters.

Are you a fugitive from those miserabl low band roundtables where you never get chance to talk, and it really doesn't matter anyway, because you have little in commo with the rest of the people in the group? I that's the case, 2 meters is definitely the banc for you. Thanks to the relative scarcity of meter vfo's, once you hook a particular sta tion, there is little chance that you'll be bothered by breakers. At least, not unles you invite them in and then tune around the band looking for them.

How would you like a wireless inter-con to keep in touch with ham friends or mem bers of your local club? Many groups are picking up surplus 150 mc commercial mobile FN rigs for conversion to 146.94 mc, the unofficial national calling frequency. Thank to a built-in squelch, these units remain silen as a mouse until some member of the gang gives out with a blast. Then, before you know it, the frequency comes alive, thanks to the numerous eavesdroppers on this ethereal par ty line. FM rigs have also proved useful to those who enjoy AFSK RTTY.

And there's even a place for TV on 2 me ters—at least the audio portion of TV QSO's Listening in on a TV QSO's a rather weirc experience, since you can't see what the boys are talking about.

Any mention of TV immediately brings to a ham's mind the business of TVI. Thank goodness, up to now, I've had no reports of in terference from my 2 meter rig. In spite of its unshielded construction, my junk box trans mitter causes absolutely no trouble with the family TV set. This is in a strong signal area with channels 2, 4, 7 and 9. The rig starts out at 24 mc with an overtone crystal. The oscillator's 2nd harmonic falls below channel 2 and its 3rd harmonic comes out above chan nel 4. The low input power probably helps also. Nevertheless, from what other 2 mete ops tell me, TVI on this band is much les than one encounters on the dc bands and is truly miniscule compared to 6 meters.

Tired of listening to the quack-quack o low frequency sidewinders? Then hop dow

2 meters where you'll encounter practically) Donald Duck talk at all. A few pioneers ıve tried the stuff out and say that it's ter-ĩic for long hauls. Successful daily skeds at stances of 150 to 200 miles are relatively ısy with a couple of hundred watts PEP ıd decent beams at both ends of the line. Un-. very recently, the lack of suitable com-ercial gear has held back the development any significant amount of 2 meter SSB ·tivity. There's little doubt that it will be a ng time before carrierless QSO's are the rule ı 2.

Believe it or not, there is a surprising nount of CW activity on this interesting ınd. The real DX'er's, of course, resort to W for long distance work whenever skip is · poor that voice signals just can't penetrate 'en the quietest receiver front end. Modu-ted CW is also popular, especially among ɘchnicians boning up for their General class :ams.

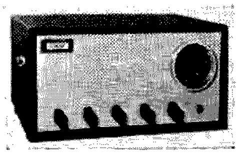
Have you heard that 2 meters is red hot ıring the summer months and then dies for e rest of the year? Well, it just ain't so! ɔme of the best band openings I've ever en-ɔuntered took place in mid-winter. While the ·eater when the weather is warm, lots of 'X comes pouring through the speaker when ıe thermometer is well below the freezing .ark.

How about giving 2 a try? Drop down and ·in with the rest of us who are having so ıuch fun. If you live within 30 miles of a g city, you'll be able to get an evening QSO ıst about any time you want to shout a CQ, ven with the most inexpensive gear. By in-kpensive, I mean something that costs no ıore than $50 and includes a transmitter, re-ɘiver and sky hook. 50 miles from a metrop-lis, you'll want at least a Communicator, oly-Comm or a Pawnee with a 10 element agi up about 50 feet. A hundred miles away, u'll be wise to feed a stacked antenna with Seneca or Zeus if you want consistently good ound wave performance. Beyond a hun-red miles, results will be spotty unless you go for high power and the best possible an-ɘnna mounted 70 or more feet above ground. ven this far away, though, if you're a pa-ent fellow willing to wait for a band open-g, modest equipment will, at times, furnish ıany fine QSO's.

Once a venerable ham wilderness, the 144 c band is now well populated. You're miss-ıg an exciting facet of the hobby if you fail ɔ make use of this interesting VHF band.

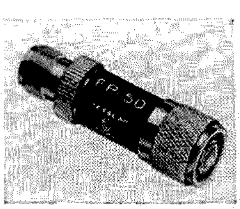
. . . W8VVD

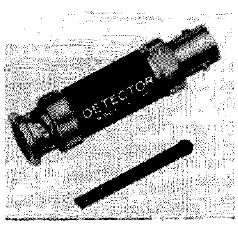
New Products



Singer Panadapter

Singer is a well-known manufacturer of laboratory equipment, such as spectrum analyzers. They've recently announced their PR-1 Panadapter for amateur use. Everyone knows the convenience of a panadapter by now, so we won't go into that much. But anyone who's ever used one says they can't get along without a panadapter. The PR-1 has a number of interesting features and costs only $144.50 FOB the factory or from your distributor. Write for more information from the Singer Company, Metrics Division, 915 Pembroke Street, Bridgeport, Conn.



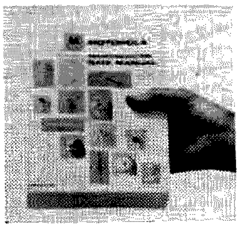


Texscan Attenuators and RF Detector

Hams doing serious experimenting need good instruments. Up until recently, they had to make their own, buy them surplus, or steal them. Now a new company, Texscan, is making coaxial attenuators and RF detectors for precision work at reasonable prices. Pads are available from one to 20 db at 50 ohms. They have excellent VSWR up through the 23 cm band. The RF detector, has excellent frequency response. Together, the pads and detectors are ideal for noise figure and antenna measurements, etc. Write for more information from Dept. 73, Texscan Corp., 51 Koweba Lane, Indianapolis, Ind.

LogDex

Tired of keeping your log in a hard-to-use old book? W6TKA has brought out an inexpensive logging system using 4 x 6 inch index cards. It can easily be filed by date or by geographical location. A number of accessories are also available. For a free sample LogDex card and price information, write to LogDex, P.O. Box 4051S, Milpas Station, Santa Barbara, Cal. 93103.

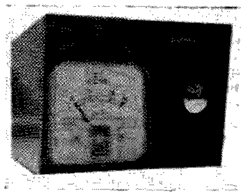


Motorola Semiconductor Manual

Hams keep asking where they can get more information about transistors. Motorola, with one of the largest lines of useful semiconductors, has just published a book that will tell them. It's a huge 908 page bound volume with complete specs on more than 2600 transistors, application guides, general semiconductor information, etc. It's a tremendous bargain at $3.50 from the Technical Information Center, Motorola Semiconductors, Box 955, Phoenix, Arizona 85001.

Sprague Suppressikits

The new car alternator electrical systems have eliminated a number of headaches of mobile operation, but have introduced a few new problems. Sprague has brought out new Suppressikits to eliminate RFI in alternator equipped vehicles. They are very easy to install and provide effective protection through 400 mc. Get more information from your local distributor.



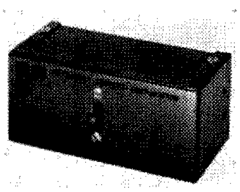
Two Battery System

Ever suffered the embarrassment of a dead ıattery in your car from too much mobile op- rating? Master Mobile can help prevent it ıappening again. They're making a dual bat- ery system for your car that gives you com- ılete control of its electrical system. Get all he information on this useful system from Iaster Mobile, 4125 West Jefferson, Los An- eles, Cal.

Free IRC Electronics Dictionary

The International Resistance Company has vised their very popular glossary of elec- ronics and is now offering it free to interested ıeople. It contains over 800 terms in its 28 ıages. Many illustrations are included to help larify definitions. The *IRC Expanded Glossary f Electronics Terminology* is available from)ept. ST, International Resistance Company, 01 North Broad Street, Philadelphia 19108.

IDC 10 meter Converter



Instrument Devices is making a little tran- storized converter for use with your car dio. It's called the SS-Ten and features easy, o-soldering installation. It draws less than 20 ıilliwatts from the internal nine volt battery. ize is 5 x 2¼ x 2¼ inches and it weighs only x ounces. Send your order with $22.95 to In- rument Devices, P.O. Box 284, Huntington, I.Y. Tell them you saw the notice in Playboy nd shake them up.

Noise Cancelling Mike

The new Roanwell lightweight, carbon, oise-canceling mobile microphone (Model M-515) is described in an eight page, 2- olor, illustrated brochure now available. It ıcludes an explanation of the principles used cancel random ambient noise which re- lts in increased intelligibility. Write Roadn- ell Corporation, Roanwell Building, 180 Va- ck Street, New York, N. Y. 10014.

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★ Price—$2 per 25 words for non-commercial ads; $5 per 2 words for business ventures. No display ads or agency di count. Include your check with order.

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★ For $1 extra we can maintain a reply box for you.

★ We cannot check into each advertiser, so Caveat Emptor . .

CONVERTERS $10 and up. World's largest selection of frequencies. Ham TV vidicon cameras and parts at low factory-direct prices. See them all now in our full page ad in this issue. Vanguard Labs, 190-48 99th Ave., Hollis, N. Y. 11423.

TOOOOOBES, TRANSMITTING-SPECIAL PURPOSE, New, Boxed, Guaranteed. . . . 6CW4—$140, 6146B—$4.75, 417A—$3.95, 826—$6.90. . . . Free Catalog. . . . Vanbar Dist. Box 444, Stirling, N. J. 07980.

DUMMY LOAD, 50 ohms. All bands up to legal limit. Size, 3 x 4 x 7. Coax connector. Kit $7.75, wired $9.75 pp. Ham Kits. Bx 175, Cranford, N. J.

COLLINS 75-A-4 OWNERS: Don't trade up! Investigate our conversion that makes the 75-A-4 a real dream. W2VCZ—30 Pitcairn Ave., Ho-Ho-Kus, N. J. 201-652-8494.

BIGGEST, Nope. BEST? Heck yes! Warren ARA Hamfest, Aug. 29. Newton Falls. Arrows from Rt. 534, Turnpike Warren Exit 14, Details: WARA Hamfest, Box 809, Warren, Ohio.

PEORIA HAMFEST September 19, Exposition Gardens, Peoria Area Amateur Radio Club, advance registration $1.00 until Sept. 11. Ferrel Lytle, W9DHE, 419 Stonegate Rd., Peoria, Illinois.

TELCO WILL PAY FOR HELP . . . we want to get the names of people who buy equipment for military and commercial applications. Our new 1 kw linear with a bandwidth of 2-30 mc is a natural for commercial use. We'll buy you a one year subscription to 73 if you'll send us the names and addresses of six commercial buyers. TELCO, Inc., 575 Technology Square, Cambridge, Mass. Current Events—

VW MOBILE 1963 sunroof sedan, green with radio, shoulder harness, 43,000 miles, HW-12, Hustler, transistor power supply. All excellent condition. D. Crosby K2VVN, 147 Charter Circle, Ossining, N.Y.

PROTECT LOW NOISE RECEIVERS—Solid state and tube front ends can be damaged or destroyed by transmitter leakage. Prevent this with broadband receiver protectors. Two models: RP-1 for 80 through 6 meters, and RP-2 for 6 through ¾ meters. Details in brochures RP-1 and RP-2. Radiation Devices Company, P.O. Box 8450, Baltimore, Md. 21234.

HRO-50T with 5 coils and SSB crystal oscillator plug-in adapter, Heath HX10 exciter-transmitter, Heath HA10 linear, Heath HO10 scope. All wired and tested by an engineer. Any reasonable offer considered. Wells Chapin, 2775 Seminole Road, Ann Arbor 48104, Michigan. Telephone 313-663-1337.

100 QSL Cards, 50 full letterheads and 50 envelopes with your name, address, etc. High quality. Fast service. $2.95 postpaid. Merchants Press, Taylor, Texas 76574.

LM-21 FREQUENCY METER, late type with power plug and schematics, $60. J. H. Gordon W5GXH, 60 Mill St., Woburn, Mass. 01801. Phone 617-933-5520 or office 617-271-3250.

HOT DX-100 250 CW 200 AM watts. NC-155. Both ex cellent condition. Will sell individually. Best reason able offer. David Wood WAØIIJ, 301 East Oakhue Olivia, Minn. 56277.

FILAMENT TRANSFORMER for that 4-1000 or 3 1000Z gg linear. 120 v 60 cy. primary. Two second aries: 7.6 v at 21 amp and 5.1 v at 13 amp. Hermeti cally sealed. Mounting studs. Standoff terminals. Un used new. Weight 14 lbs. $4.50 plus postage. AR Sales, P. O. Box 12, Worthington, Ohio.

ERIE VHF HAMFEST. Brookside Fire Hall. Sunda September 19. Write WA3ANA, 4300 Cooper Road Erie, Pa. for more information.

HEATH HR10 RECEIVER $65. WØIZV, 7927 Durang St., Denver, Colo. 80221.

WE WILL PAY CASH OR TRADE . . . On popula clean, unmodified amateur gear. World Radio Labora tories, Box 919, Council Bluffs, Iowa.

UHF: 2C39's and 3CX100A5's. Pullouts but tested goo at 432 mc. $1.50 each or 5 for $600 postpaid. Le Malone WA5DAJ, 4305 Windsor Dr., Garland, Texa

572B's: Matched set of 4. Factory fresh and boxe never opened. $39.50 per set or $9.95 each postpai WA5DAJ, 4305 Windsor Drive, Garland, Texas.

HIGH POWER class B modulator. Pair 805's, 2A drivers. Complete with schematic, $40. Power suppl 1500/1250/1000 v at 500 ma. Paid 866's complete, $3 Stancor plate transformer 2500 v at 300 ma/2000 v 500 ma, $20. WA1BLY, 9 Lownds Ave., Easthampto Mass.

NEW HEATHKIT SB-400 transmitter and SB-300 re ceiver. Both excellent condition. SB-400, $300. SB-30 $225. Both $500. Jim Chancey K8ZPP, 125 Morningsid Circle, Parkersburg, West Virginia.

L.I. HAMFEST. The Federation of Long Island Radi Clubs will hold its annual Hamfest and picnic at th Hempstead Town Park, Point Lookout, Long Island o Saturday August 28 from 9:00 AM to dark. Plan a outing for the entire family. The park features ocea swimming, boardwalk, playground area for the chil dren, golf and food service.

GONSET SIX METER SIDEWINDER and power sup ply. Perfect condition. $300 or best offer. HQ140X PSA63A, Tecraft 6 meter converter. Craig Reinhard WAØAUB, 8600 Crystal, Kansas City, Mo. Tel 816-35 2458.

ZERO-BEATERS ARC HAMFEST. City Park, Was ington, Mo. August 1, 1965. Pre-registration $1. Co tact WAØFYA Lester Maune, 1010 Esther Stree Washington, Mo.

FOUNDATION FOR AMATEUR RADIO HAMFES September 19th at Ft. Belvoir, Virginia about 17 mil south of Washington. Contact W. R. Russell W3BOS 1022 17th Street, N.W., Washington, D.C.

SOUTH JERSEY RADIO ASSOCIATION HAMFES September 12 at Molia Farms, Malaga, N.J. Rain dat September 26. Joe Duffin W2ORA, 247 King's Highwa West, Haddonfield, N.J.

MODEL 15 TELETYPE, sync motor, holding magnets. Recently cleaned, overhauled, cabinet refinished. Table included. Write for details. WAØDNB, 606 N. 8th. Missouri Valley, Iowa.

HALLICRAFTERS HA-2 SSB 2m transverter, matching P-26 P/S $150; TAPETONE SB-50 SSB 6m transmitting converter, Model 201 receiving converter both brand new $75; HARVEY WELLS TBS-50D, matching P/S $45; will consider swapping all or part for mobile SSB transceiver. BENJAMIN, K1SLZ, 11 Douglas Rd., Lexington, Mass. 617/862-1541

TRADE Galaxy III w/AC and console, brand new, for 75A4 or sell. Trade Propane carburetion equipment for Car or Truck for Ham Gear. WØBNF, Box 105, Kearney, Nebr.

HP-23 BRAND NEW HEATHKIT AC supply for Heathkit and other transceivers. Assembled, unused. $36 or best offer. Ken Ginsburg, K8VKC, 790 E. 254, Euclid, Ohio.

CANADIANS: BC375 transmitters 75 watts cw 50 am new $17.50. BC459A 40 meter transmitters new $13.95. TA12C $24.95. Shipped cod. Longmire's Surplus Waterville Nova Scotia.

SYRACUSE VHF ROUNDUP in its 11th year will be held Saturday, October 2nd at Three Rivers Inn, Liverpool, N.Y. Speakers! Mfgrs Displays! Prizes! and Dinner for only $6.00 pre-registration; $6.50 at door. Tickets-Reine Maavere, 2217 E. Colvin St., Syracuse, 13210

BLUE BOOK used list free! Check our low prices. Over 1,000 items. Includes: KWM2, Eico 720, AF68, PMR8, Galaxy 300, 755A VFO, Communicator 3/6, SX42, SX101A, SX117, SR150, SB400, Invader 2000, Viking 500, CM1, 32V1, 22'er, 2A, Champ 350, Globe 6-2. Free 1965 Catalog, World Radio Laboratories, Box 919, Council Bluffs, Iowa.

SSB STATION, 160-10. SX-100 w/speaker $150, Phasemaster II, matching VFO 90w PEP $150. Excellent condition. John P. Skubick K8ANG, 1033 Meadowbrook, Warren, Ohio 44484.

HEATH HX-30 6 meter SSB + AM transmitter, $120. HW-32 20 meter ssb transceiver, $95. Both like new. 16810 Weddington, Encino, Calif. Phone 213-784-2588.

HEATH SB-400 exciter, Hy-Gain TH-4, CDR TR-44, Brush BA-200-2, misc ham station parts. Money back guarantee. Make offer or send for price list. W9FMW, 1567 Southfield Road, Evansville, Indiana 47715.

BANDIT 2000A Linear Serial 439 complete with Hunter Bias modification excellent condition $375.00. Also Newtronics 80-40 meter Cliff Dweller Serial 503 good condition $50.00. Both units F.O.B. K4ZJF Milt de Reyna 4030 Hallmark Dr. Pensacola, Fla. Phone 433-6552.

SELLING RCVR, Heath GC-1A with AC and battery pwr supplies and Heath QF-1 Q multiplier. Excellent condition. Only $89. Richard Crow, Indian Hill Rd., Groton, Mass. 01450.

ANYONE KNOW where I can obtain a CV-253/ALR Converter at a reasonable cost? Also in the market for an unusual QSL card. K7VOY, 6831 East Moreland, Scottsdale, Ariz.

LARGE LIST GOVERNMENT SURPLUS ELECTRONICS MANUALS—35¢ for complete list, postpaid. Other manuals available, all subjects, send needs. MIP, POB 9867 (73-1) Dallas, Texas 75214.

MISSOURI-ILLINOIS—The Egyptian Radio Club will hold its annual Hamboree on Sunday Sept. 26, 1965 at the Club House. One half mile south of the Chain of Rocks Canal Bridge (Hy. 66 by pass) near Granite City, Ill. Games and contests for the entire family. Ample parking space. Soft drinks, coffee and sandwiches. For details write Cletus Woodard, W9IHE, P.O. Box 402, Granite City, Ill.

INDEX TO ADVERTISERS

Propagation Chart

September 1965

J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	7	7	14	14	14	14	14
ARGENTINA	14	14	14	7	7	7#	14	14	14	14	21	21
AUSTRALIA	14	14	14#	7#	7	7	7	7	7	7#	14#	14
CANAL ZONE	14	14	14	7*	7	7	14	14	14	14	14	21
ENGLAND	14	7	7	7	7	14	14	14	14	14	14	14
HAWAII	14	14	14	7*	7	7	7	7#	14	14	14	14
INDIA	14	14#	7#	7#	7#	14	14	14	14	14	14	14
JAPAN	14	14	7#	7#	7	7	7	14	14	14#	14#	14
MEXICO	14	14	14	7	7	7	14	14	14	14	14	14
PHILIPPINES	14	14#	7#	7#	7	7	14	14	14	14	14#	14
PUERTO RICO	14	14	7	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	7	7	7#	7#	7#	14	14	14	14	14	14#	7#
U. S. S. R.	14#	7	7	7	7	14	14	14	14	14	14	14
WEST COAST	14	14	14	7	7	7	7	14	14	14	14	14

CENTRAL UNITED STATES TO:

ALASKA	14	14	14	7*	7	7	7	14	14	14	14	14
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CANAL ZONE	14*	14	14	14	7	7	14	14	14	14	14	21
ENGLAND	14	7	7	7	7	7*	14	14	14	14	14	14
HAWAII	14	14	14	14	7	7	7	7#	14	14	14	14
INDIA	14	14#	7#	7#	7#	7#	7#	14	14	14	14	14
JAPAN	14	14	14#	7#	7	7	7	14	14	14#	14#	14
MEXICO	14	14	7*	7	7	7	7	7	7*	14	14	14
PHILIPPINES	14	14	14#	7#	7	7	7	14	14	14	14#	14
PUERTO RICO	14	14	7*	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	7	7	7#	7#	7#	14	14	14	14	14	14#	7#
U. S. S. R.	14#	7#	7	7	7	7#	14	14	14	14	14	14

WESTERN UNITED STATES TO:

ALASKA	14	14	14	14	7	7	7	7	7*	14	14	14
ARGENTINA	14	14	14	7	7	7	7#	14	14	14	21	21
AUSTRALIA	14*	14*	14*	14	14	7	7	7	7	7#	14	14*
CANAL ZONE	21	14	14	14	7*	7	7*	14	14	14	14	14*
ENGLAND	14#	7#	7	7	7	7	7	14	14	14	14	14
HAWAII	14	14*	21	14	14	14	7	7	14	14	14	14
INDIA	14	14	14	14#	7#	7#	7#	14	14	14	14	14
JAPAN	14	14	14	14	14	7	7	7	14	14#	14#	14
MEXICO	14	14	14	7	7	7	7	7	7*	14	14	14
PHILIPPINES	14	14	14	14#	7	7	7	7	14	14	14#	14
PUERTO RICO	14	14	14	14	7*	7	7*	14	14	14	14	14
SOUTH AFRICA	7	7#	7#	7#	7#	7#	7#	14	14	14	14#	7
U. S. S. R.	14#	7#	7	7	7	7	7#	14#	14	14	14	14
EAST COAST	14	14	14	7	7	7	7	14	14	14	14	14

Very difficult circuit this hour.
* Next higher frequency may be useful this hour.

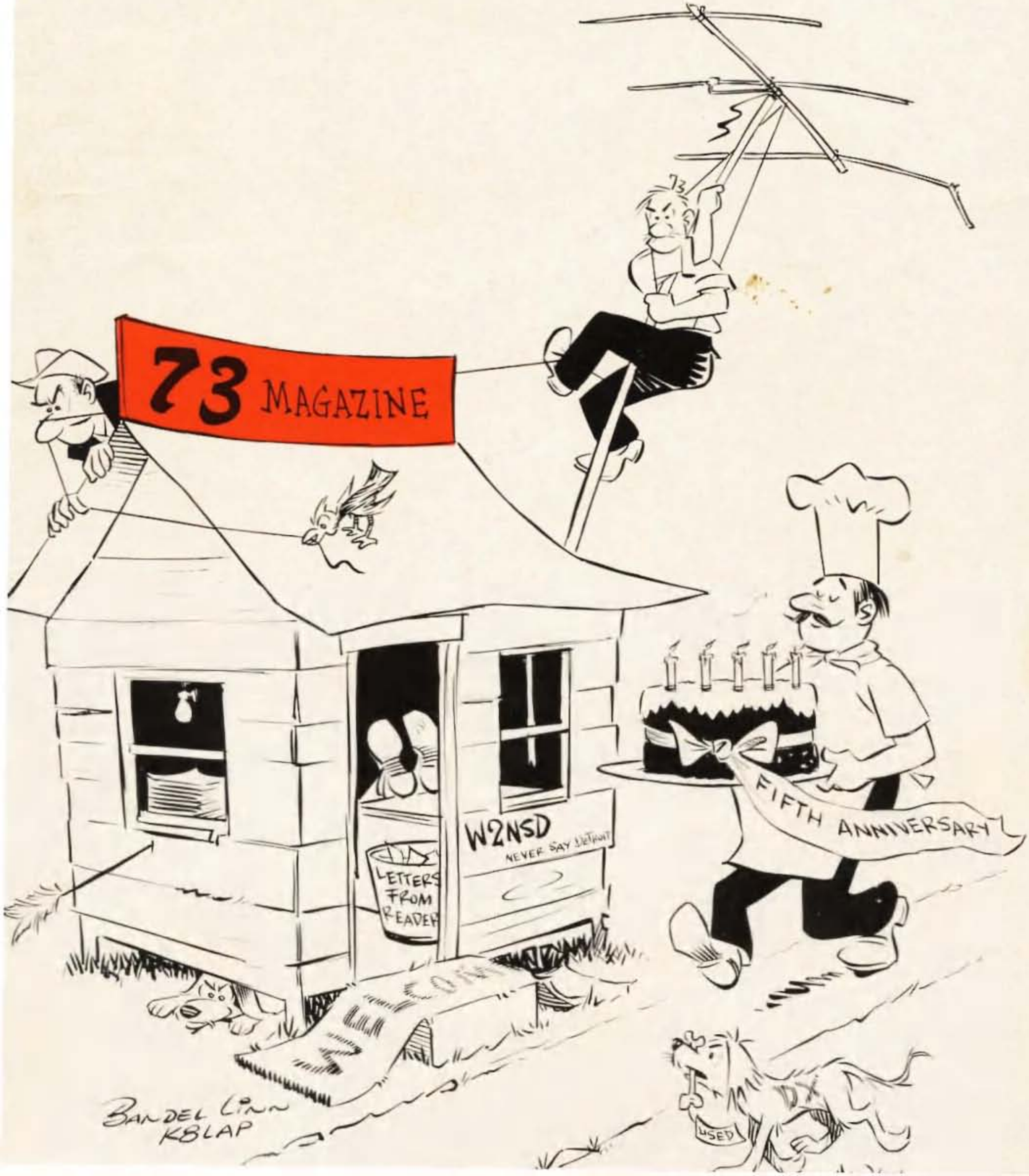
Good: 1, 2, 13-16, 19-21, 28-30
Fair: 8, 10, 17, 18, 22, 24, 26
Poor: 3-7, 9, 11, 12, 23, 27
VHF DX: 1, 2, 11, 12, 22, 23

73

OCTOBER 1965

An anniversary 50¢

Amateur Radio



73 Magazine

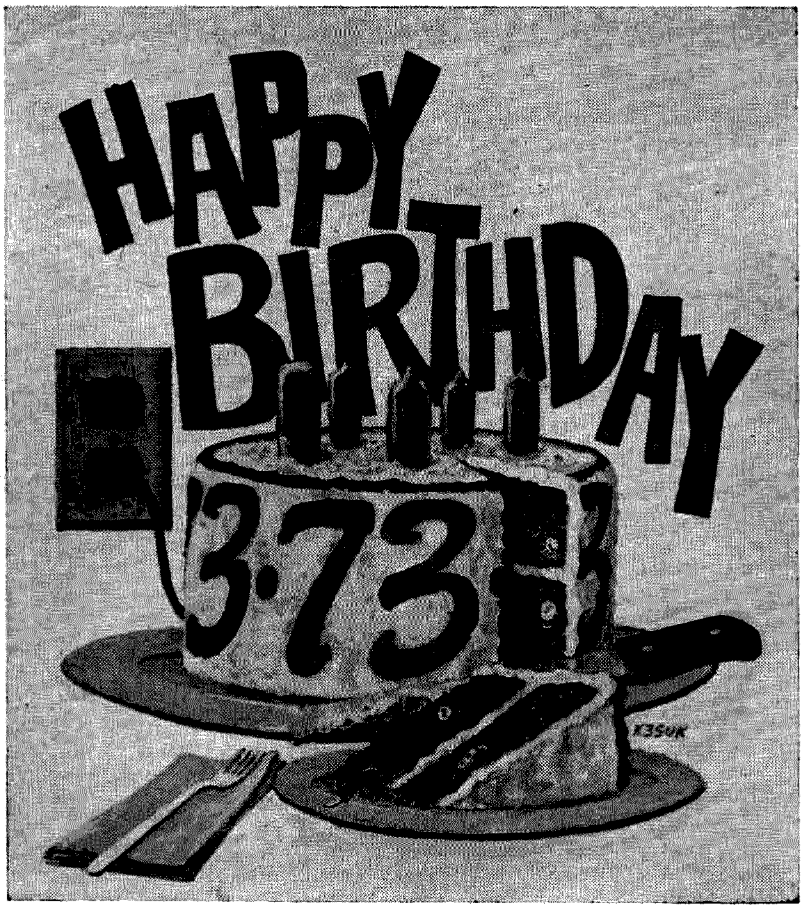
Wayne Green W2NSD/1
Editor & Publisher

Paul Franson WA1CCH
Assistant Editor

October, 1965

Vol. XXXVI, No. 1

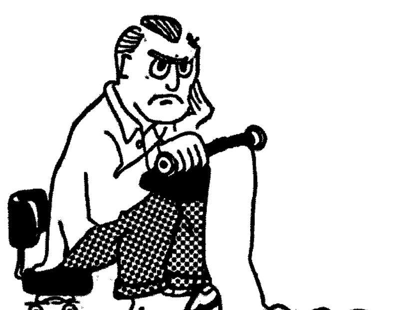
73 Magazine is published monthly (thank heavens it's not weekly) by 73, Inc., Peterborough, N. H. Zip 03458 (terrible number). The phone is 603-924-3873. Subscription rates $4.00 per year, $7.00 two years, $10 three years world wide. Second class postage is paid at Peterborough, New Hampshire and at additional mailing offices. Printed in Bristol, Conn., U.S.A. Entire contents copyright 1965 by 73, Inc. Postmasters, please send form 3579 to Good Old 73 Magazine, Peterborough, New Hampshire. Use your Zip Zone and save our shirt.



de W2NSD/1

never say die

Five years?
Oi.
Well, it's better than working for a living.



Interlopers

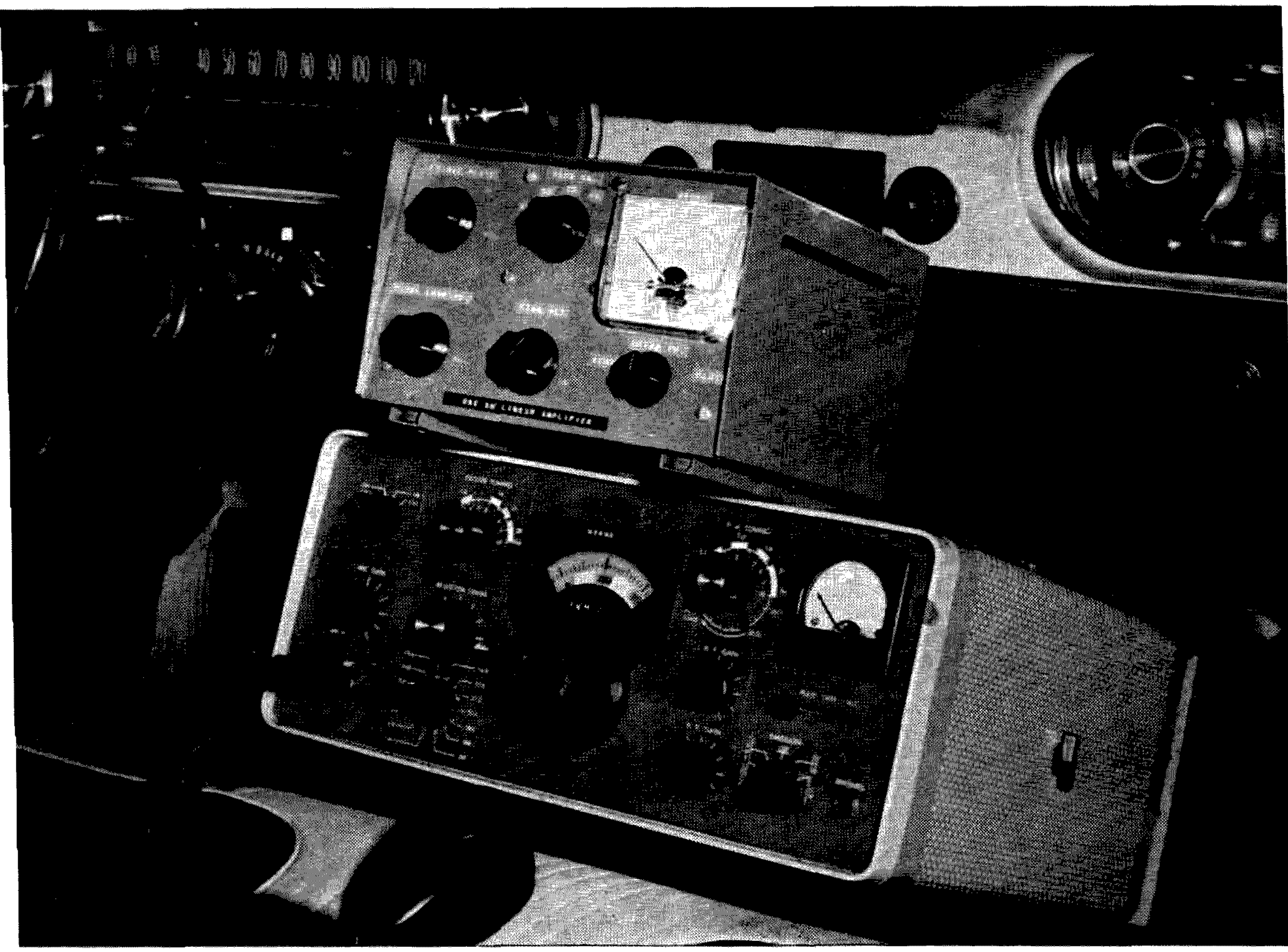
Perhaps it only seems as though there are more non ham stations in our bands? Well, if you are good at listening you will be able to log the following Voice of America broadcasts: 3965, 3980, 7105, 7110, 7115, 7125, 7130, 7135, 7145, 7150, 7155, 7160, 7170, 7175, 7195, 7200, 7205, 7235, 7240, 7250, 7255, 7270, 7275, 7290, 7295. The last copy of a complaint that I saw addressed to VOA brought the response that since all the other short wave broadcasters are in the ham bands they have to be too. But do they have to completely blanket the band like that? It looks like we are overwhelming them, not just keeping up.

Ham Hotel

Since I was going to Puerto Rico to write up the 432 test at Arecibo, I checked into what it would cost to add Curaçao to my itinerary. The round trip fare to Puerto Rico was $133, and the fare to Curaçao and back, with stops at Puerto Rico was only $150 on a 17 day excursion. For $17 extra I would be foolish to pass up Curaçao.

I dropped a letter to Chet PJ3CC, the owner and manager of the Coral Cliffs Hotel, telling

Continued on page 122



2 KW Mobile

For many years I've had to travel a lot. During this time, I've operated mobile with commercial and home-brew equipment in the 150 watt range—and with good results. But I kept wondering how it would be to run a full gallon in the car. So I tried it. To my surprise, it turned out to be well worth the time, money and effort I spent. Here's how I did it:

Richard Yeomans W2DMK
1243 Front Street
Binghamton, N. Y.

The Alternator

I am sure that we all know the limitations of car batteries and generators. They are only good for about 35 amp DC maximum. Subtracting required automobile needs leaves little for ham equipment. An alternator seems to be the only practical solution. My car, unlike newer ones, didn't come with an alternator. In fact, a stock alternator wouldn't have been sufficient for a kilowatt anyway. Even heavy duty truck alternators are only rated at about 60 amp DC.

So I bought a guaranteed used Leece-Neville alternator through a Ham Ad for $85 complete with regulator and copper oxide rectifier stack. It was rated for 100 amp at 14 volts DC CCS. The price has gone up since then, but they're still a bargain.

Alternators have many advantages over generators:

1. Small size, moderate weight, little maintenance required.
2. High output current even at idling speeds.
3. Excellent regulation of the output voltage.
4. Little RF interference.
5. High frequency output. For example, the frequency at 2500 RPM is about 250 cycles. This frequency is proportional to alternator speed. Higher frequencies are easier to filter than low ones (such as 60 cycles.)
6. Little chance of burning out. An overload will cause either a loud whine from a slipping belt or the output current will remain constant instead of increasing.

There were two things that I didn't like about the alternator I got, though. The copper oxide rectifiers deteriorate with age and develop a high back resistance. This causes the rectifiers to overheat. Since they normally run hot as it is, I replaced them with high current silicon diodes mounted on a good heat sink. This eliminated the heat problem.

Also the vibrating reed regulator was unreliable. When it was hot, the battery wouldn't stay charged. In cold weather, the battery was overcharged. All electrical-mechanical regulators suffer from temperature effects.

In looking for a solution to this problem, I came across an article by Harry W. Lawson in the August 1961 Electronics World. I built a regulator from this article and it worked like a charm. Temperature didn't seem to affect the output voltage of the alternator. The interference from the clicking contacts has been eliminated. But the biggest advantage was that the output voltage of the system could be set by adjusting one small pot. This regulator has been trouble free for three years.

Now that we have primary power, let's turn to the DC supply for the linear.

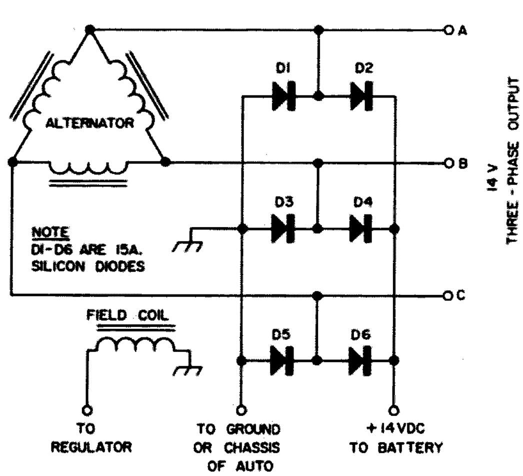
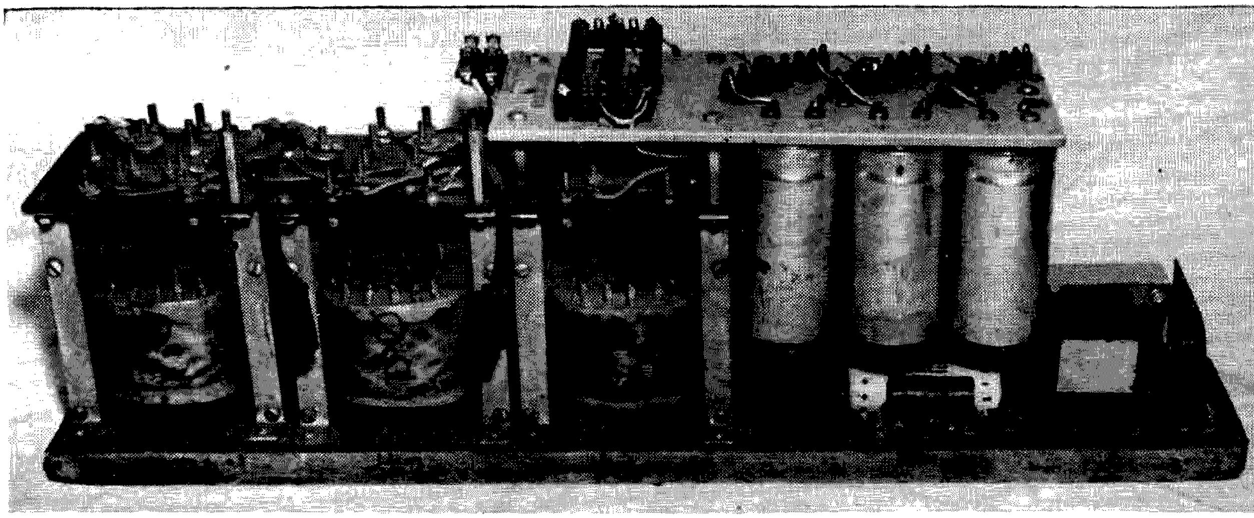


Fig. 1. The primary power system.



The power supply: Notice the husky filament transformers, the fuses, the bleeder resistors, the diodes, the voltage doubler capacitors, the bias supply and the bias transformer.

The DC Power Supply

The DC supply is conventional—but may be new to hams. As can be seen in **Fig. 2**, the three husky filament transformers are connected in reverse. The 12.6 volt windings become the primaries and are connected in delta fashion to match the output of the alternator. Each secondary uses a full wave voltage doubler and develops approximately 750 volts. The three outputs are then connected in series to develop about 2250 volts at 450-500 ma.

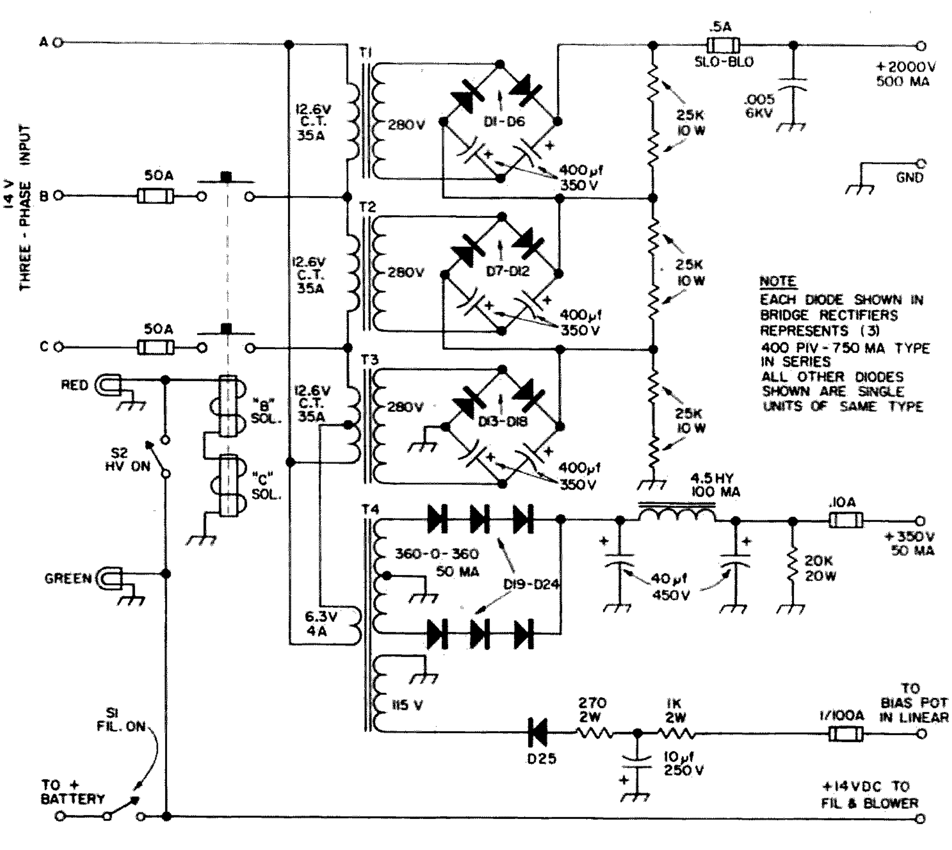


Fig. 2. The power supply for the linear. Note that input is three phase.

This voltage and current is maintained with a charging voltage of 14 volts from the alternator.

The transformers shown are surplus. There are many similar ones available from the surplus dealers who advertise in 73.

A small replacement transformer rated at 350 volts each side of center at 50 ma, 6.3 v at 4 amp and with a 115 v primary is used to furnish bias and screen voltages. The 6.3 volt winding becomes the primary and is connected to phase A at the center tap point of this transformer. The 115 volt winding becomes the bias source.

The diodes are standard TV replacement types. The capacitors in the voltage doubler are surplus. You probably could use 100 µf electrolytics with slightly poorer regulation. Each of the 750 volt outputs is shunted by a 50 k, 20 watt resistor that acts as a voltage equalizer and bleeder.

The high voltage supply is switched into action by energizing two six volt auto started solenoids connected in series. They complete the circuit of phase B-C to the transformer. Phase A leg will not supply any voltage without one of the other legs connected. I used six volt solenoids since they were cheaper than twelve.

The filaments and blower are designed to be switched on at least three minutes before the plate supply is energized.

The Linear Amplifier

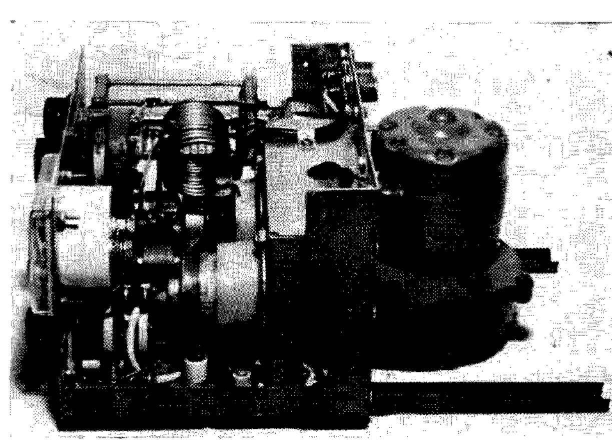
This amplifier is a little unusual. It is a grounded grid *tetrode* amplifier. The 4CX250B tube is not suitable for regular grounded grid operation (that is, with the control and screen grids both grounded), for screen and grid currents will run too high and ruin the tube. But they work fine as tetrodes with drive applied to the cathode, the grid grounded and the screen at about 350 volts. As in true grounded grid, about 80% of the drive shows up in the output. Drive required is higher than class AB, but less than grounded grid. An exciter with 65 watts output will drive the pants off this linear on all bands—even ten.

You've probably noticed from the schematic that I didn't include eighty meters in the linear. If you want to, you'll have to use larger pi network capacitors or switch in some extra capacitance on this band.

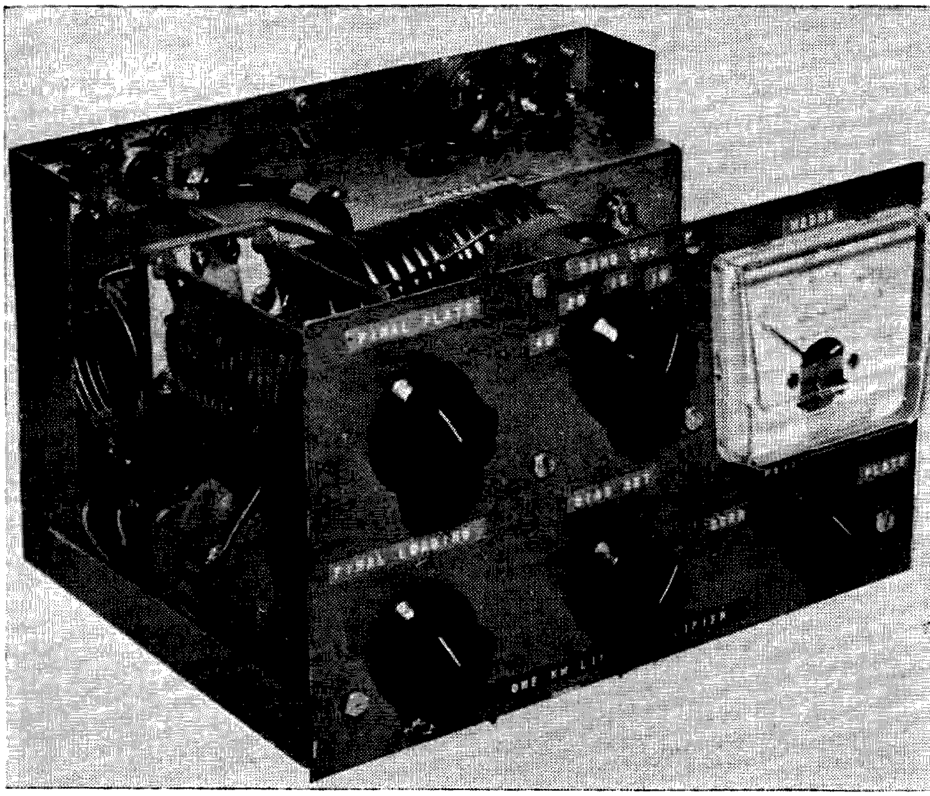
I didn't use on L network in the cathode circuit of the linear. An RF choke worked fine. If your exciter output is less than 65 watts PEP, you probably will need a tuned input.

The amplifier was neutralized to improve its stability, but this turned out to be unnecessary. The neutralizing capacitor is a piece of brass flat stock ¼" by 7" mounted ¼" away from the plates of the final tubes. It is supported by three steatite stand-offs one inch long.

The screen and cathode currents are read with the flip of the meter switch. When the amplifier is properly loaded, cathode current



The side view of the linear shows the 4CX250B's mounted horizontally with the blower fastened to the back of the cabinet.



The 4CX250B linear. Operation is very simple. The only controls are tune, load, bandswitch, meter and bias set.

is about 550 ma at 2000 volts. The screen current is 50 to 60 ma at 350 volts. This current should not be exceeded; if it is too high, increase loading. If the current is too low or negative reduce loading. These readings are with full carrier.

Bias should be set for about 100 to 150 ma resting current with 2000 volts on the plates. Once set, this current does not need adjustment.

The 40 cfm squirrel-cage blower is probably a little husky for this job, but the extra air helps to keep the tubes real cool. Incidentally, the amplifier helps heat the car on cold mornings with its 200 watt dissipation!

Checks with a Collins watt meter and the old fashioned RF ammeter and voltmeter shows that the amplifier gives excellent efficiency. One kilowatt DC in gives about 650 watts RF out.

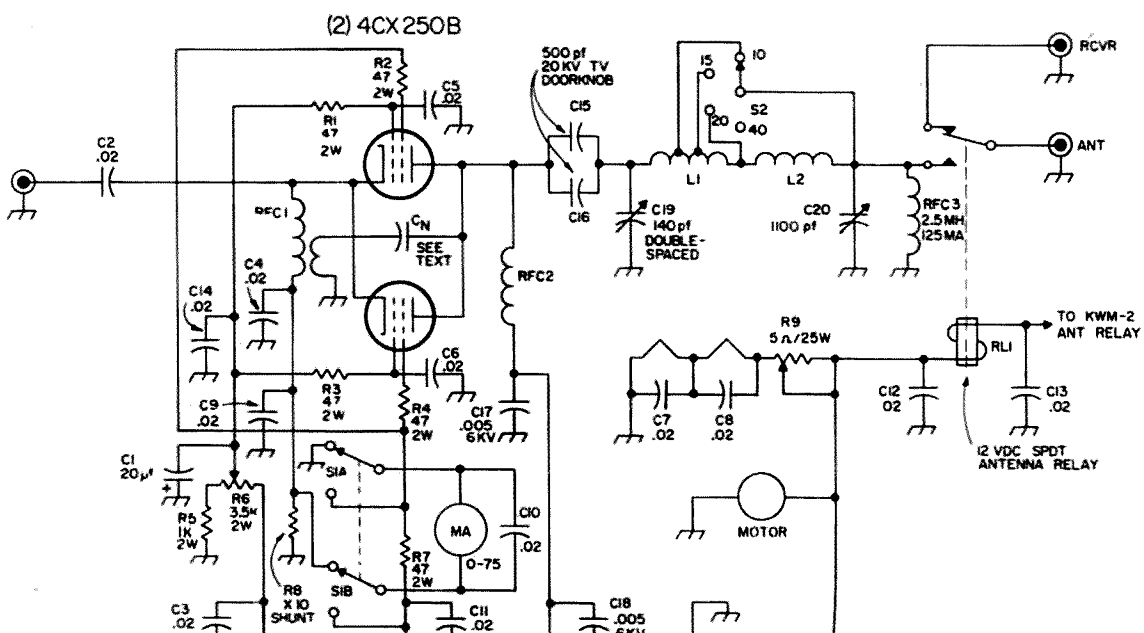
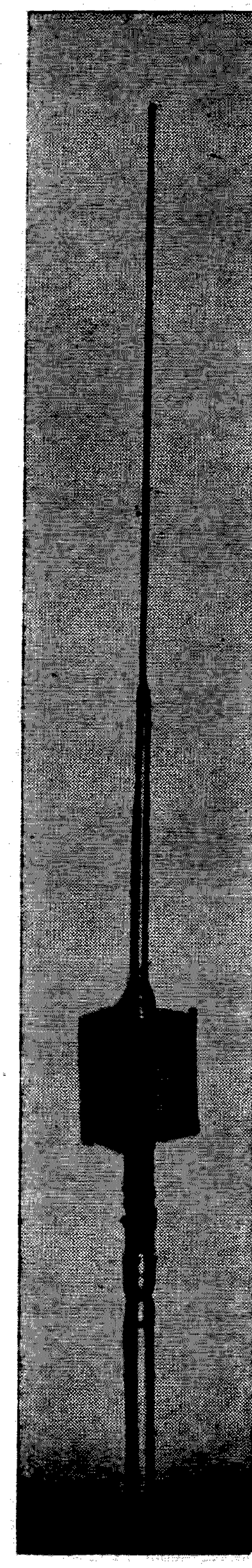


Fig. 3. The linear amplifier for 2 KW mobile.

The modified Newtronics top loading antenna. As mentioned in the text, commercial antennas for a full KW are now available.



The Antenna

Yes, you are correct in wondering what commercial mobile antenna will handle two kilowatts. I have tried a variety of commercial and home brew designs: helical wound, base loaded, center loaded, top loaded and trap. I found that the center loaded type with three foot base section, loading coil and five foot top section was quite effective. The loading coil was of heavy B & W stock two and a half inches in diameter. A separate coil was plugged in for each band. This antenna was used for about four years of mobile hamming.

But I am curious, so I wanted to try the Newtronics Hustler top loaded antenna. I did. But, as I feared, the loading coil was not designed for this power. The new high power coils would be fine, but this was before they were announced, so I made my own coil from more B & W stock. The one illustrated is for twenty meters. Be sure to coat the coil thoroughly with Krylon or epoxy if you make your own coil. Otherwise, water between turns will short out part of the winding with attendant loading problems and fireworks.

I made a few tests and found that the top loaded antenna seemed to increase both received and transmitted signals over a center loaded whip in the same position on the car.

It is easy to find resonance with this antenna. Just slide the top tuning rod in and out a quarter inch at a time while checking the SWR. I used a 20¼ foot length of RG-8/U between the linear and the antenna.

Corona loss at this high power is high. Even so, all signal reports have proven to me that the extra power has more than paid for itself. I'm happy with my high power mobile. I think you will be, too.

. . . W2DMK

Photography by Don Abbott WA2MZQ.

Meterama

Howard Burgess W5WGF, 1801 Dorothy Street N.E. Albuquerque, New Mexico

Meters are one of the few electronic components that impress both technical and nontechnical hams. To the technician they show what is happening in a circuit. To the nontechnical person only a flashing red light outranks them as the sign of a true professional.

But meters have another feature that is less appealing. They are one of the most expensive parts in a circuit. If your use of meters is limited by their cost, perhaps you are overlooking a source of bargains that is passed up every day by many.

There is an almost endless supply of meters that no one seems to want. Thousands of instruments that originally cost as high as $150 or more apiece are available for less than 2¢ on the dollar. These are the meters with the oddball scales. They are calibrated in everything from "miles-per-hour" to "Degrees C." They can be found on bargain counters, in salvage yards, old military equipment, and all sorts of obsolete testers.

Perhaps you are wondering why a meter that costs as much as $150 may sell for as low

as $2. The answer is simple. Who wants to measure plate current in "pounds-per-inch?" However, with a few simple tools and some spare time, most of these units can be converted into beautiful instruments. Even custom-tailored or personalized scales with professional quality are simple to turn out.

The first step in converting these meters is to find out as much as possible about the basic movement. The foundation unit, or movement, of almost all panel meters is either a microammeter or milliammeter. This applies even to voltmeters. Even though the scale may read in "gallons-per-minute," the chances are very good that it is still a DC meter.

To make good use of a meter it is necessary to know how much current is required to make it read full scale. Many times this information is simple to find; it may even by written in the very lower portion of the face plate in tiny figures. Figures such as "FS=100μa" mean that the meter is 100 microamperes full scale. Or, "1MAFS" means that "1 milliampere" will give a "full scale" reading.

If the meter happens to be one with the "0" in the center of the scale, the letters down in the corner may read ES=1MA. This says the meter will read full scale "each side" with "one milliampere."

If the meter happens to be one that was made for military use, you may find an odd assortment of numbers and letters on the face. A typical meter can have something like this on the face:

MR13S001DCMAR

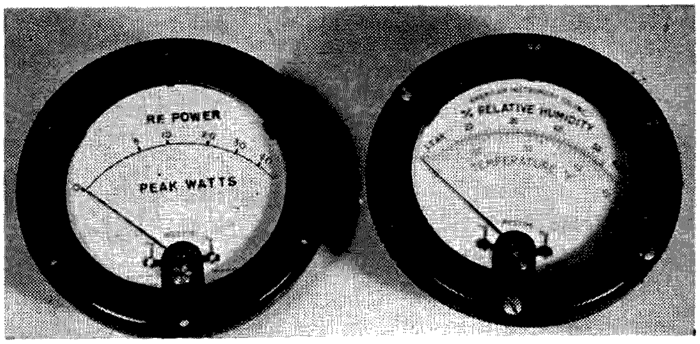
The first five places on the left can be disregarded. They are coded symbols that tell the size, shape, and color of the meter. You already know this if you have the meter. The eight places on the right carry the information that is important.

The three places in the center shown as "full-scale-value" tell what the meter reads full scale. In this meter it is 1. The next two places show what kind of current the meter reads and for this meter is DC. The two places following tell the electrical units in which the meter is calibrated and in milliamperes. The final R tells that the meter is ruggedized.

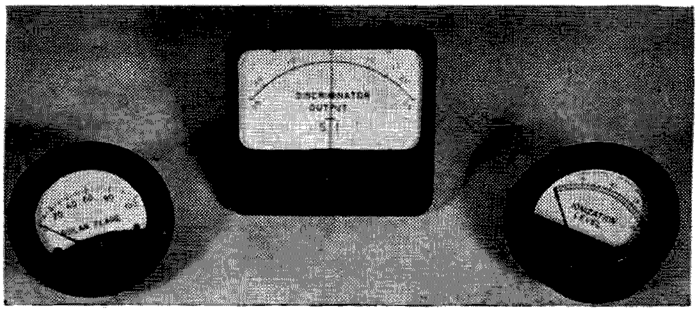
If the three places that are used to indicate "full-scale-value" happen to have an R in the center space, the R is read as a decimal point. As an example the figures 2R5 would indicate a full scale value of 2.5 units.

When the scale gives no clue to the meter's full scale sensitivity, it will be necessary to run a few simple tests. The circuit shown in **Fig. 1** can be put together in a few minutes for quick measurements. The resistor R3 will limit the maximum current that can be put through the meters. The meter shown as X is the one being tested. Meter S is a meter with known calibration and is used as a reference. The meter or meters used at S should be able to cover the range from 100 μa to 100 ma or more. This spread will accommodate most basic meter movements.

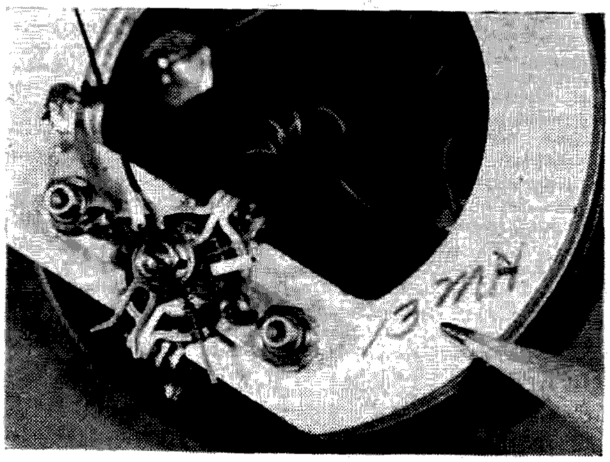
When the circuit is complete the resistors are adjusted until meter X reads full scale. The full scale sensitivity of the unknown meter is then read on meter S. As a precaution to safe-



Before and after. The odd temperature meter at the right was changed into the indicator for an RF power meter. In this case a full new scale was made.



Three old clunkers plus a few hours work produced these three custom meters for special test equipment.



The meter sensitivity is sometimes given inside the case.

guard the meters adjustments should be started with the largest value of R3 and decreased as required.

The accuracy of the calibration will depend to a large extent on the meter S. This meter should be the best available but even a volt-ohm-milliammeter can serve the purpose.

When the sensitivity has been determined, the uses to which the meter can be put is easily decided. We can now rework the scale accordingly.

Before opening the case pick a working area with good light and free of dust, *especially small magnetic particles* such as filings. The case is carefully opened (usually by removing the small screws around the outside of the case shell.) Remove the screws that hold the face on, being very careful not to touch the pointer. The face can then be *slid* out from under the pointer. A glass bowl should be turned upside down over the open meter to protect it while the scale is being reworked.

In some panel meters the scale is made of paper and glued to a metal plate. However in most cases it is a coating of white enamel on the metal plate. With the enamel scale unwanted lettering can usually be removed with a little careful rubbing and a small amount of cleanser such as Ajax moistened with water. A clean ink eraser or the edge of a razor blade can be used to clean up small areas.

If the divisions on the original scale can be used or adapted they should be left on the face. New scale divisions should not be attempted without some advance practice. Of course new scales can be made on paper first and then cemented to the face plate.

When a meter is reworked, even the best intentions and effort can end with poor results if crude lettering is used. If more than one or two meters are to be converted, it is well worth the investment to obtain a few simple lettering tools. For professional-looking work, we would suggest several pieces of *LeRoy* equipment. (LeRoy is a trade name used by the Keuffel and Esser Co.)

In the LeRoy method a special pen point is held in a scribing tool which follows a template. The template is engraved with the alphabet and numbers and is available to give all sizes and types of characters and numbers. With a few minutes of practice, perfect lettering is possible. A complete set of LeRoy equipment is far more expensive than most of us can afford. However, pieces can be purchased separately as needed for meter work and the total cost will be less than the price of a new meter.

In addition to their value in meter work the special pens can be used to letter panels, chassis, drawings, and almost anything requiring lettering. Various sizes of templates can be added to the collection as needed. As a start we would suggest a scriber (No. 3237-2), a size 120 template (No. 3240) and a size 0 pen. Larger or smaller letters can be had by using other templates. The pen size will determine the thickness of the line. Size 000 pen makes a very fine hair line and the width will increase with an increase in pen number. Size 6 will give a line almost 1/16 inch wide. Almost any good drawing ink can be used in the pen. This equipment can be obtained from stores selling engineering drawing supplies.

The meter face to be lettered should be fastened firmly to a flat surface or drawing board with masking tape. Before beginning on the meter face a few practice runs should be made on paper to determine the proper spacing. Be sure to use a light touch when working on the enamel meter face. This will keep the pen from scratching the enamel under the ink. If a mistake is made, the entire ink work can be washed off and a fresh start made with no scratch marks visible.

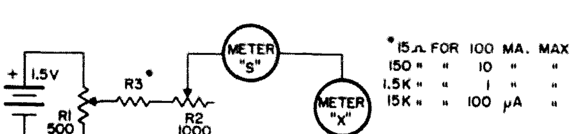


Fig. 1. Determining the sensitivity of the meter. Using the LeRoy set.

After the face of the meter has been reworked and the meter reassembled, the meter can be given a complete calibration or the sensitivity can be altered by using shunts. The selection and use of shunts and dropping resistors will not be covered here as almost all radio handbooks carry a chapter on this subject.

The final calibration should be made by comparing the instrument with the best standard that you have available. If you plan to do a number of meters, a special calibrator is a great time saver, and the construction of such a unit is relatively simple.

And what if you do flub the first one, or even the second one? The next one will be a masterpiece. Just remember: *meters have a unique distinction!* Where else can you write off a $150 loss on a $2 investment?

. . . W5WGF

Silver Plating

Ever put off or forgotten about building a VHF or UHF tuned line tank circuit because construction techniques for optimum performance required silver plating? Well, no more is there need to evacuate the fish population from the aquarium for its use as an electrolysis tank . . . or turn your wallet over to a professional plating business.

A product is now on the market in a powder form which enables you to silver plate at home with only such simple articles as abrasive cloth and a slightly damp cloth pad! And it really works!

Known as "Cool-Amp Silver Plating Powder", it deposits a genuine coat of silver that will not peel off and is equal to electroplating. Simple instructions for use consist of only two basic steps:

(1) Polish the copper, brass or bronze surface.

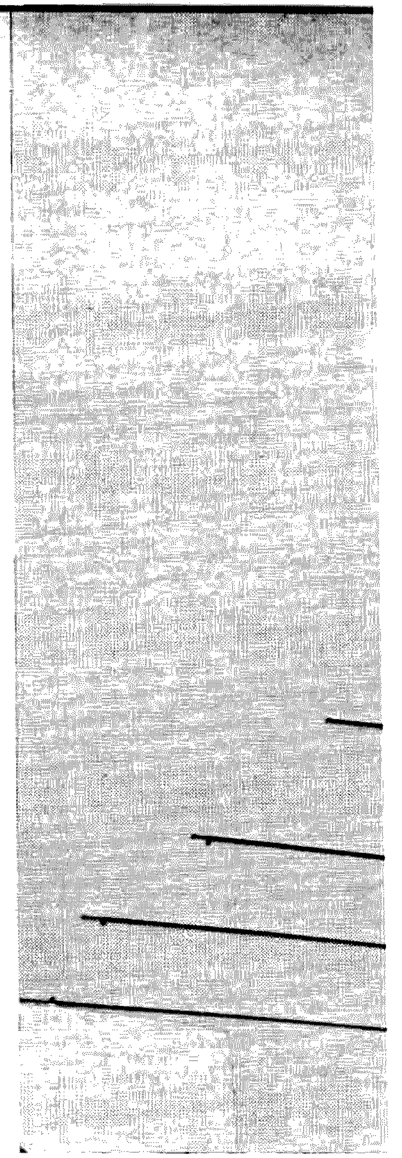
(2) Apply the silver plating powder with a slightly damp cloth pad, about the size of a half dollar, by alternately dipping into the powder and rubbing firmly on the metal.

The silver plating powder may be ordered direct from the manufacturer, The Cool-Amp Company, 8603 S.W. 17th Avenue, Portland 19, Oregon. A pound bottle will silver plate approximately 6,000 square inches. The price is $13.50 for the pound, however in view of the large area which can be plated, the cost and the powder could be split between two or more of the local amateur radio gang.

. . . W3WTO

Ronald Lumachi WB2CQM
73 Bay 26th Street
Brooklyn, New York

Six for Six



As all hams know, activity on six has been very high since the band was opened to Technicians. Any one who is determined can learn enough to pass a Tech license test in a fairly short time. So now this is the second largest class of licenses and most active Techs are on six. This has caused a lot of QRM on the band; only the best equipment is useful for fighting the other stations, particularly for DX.

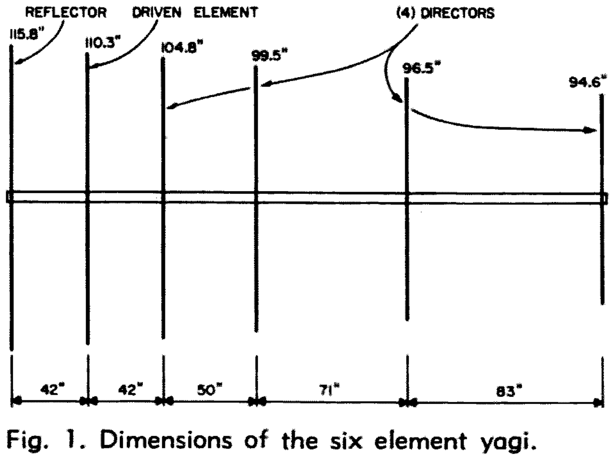


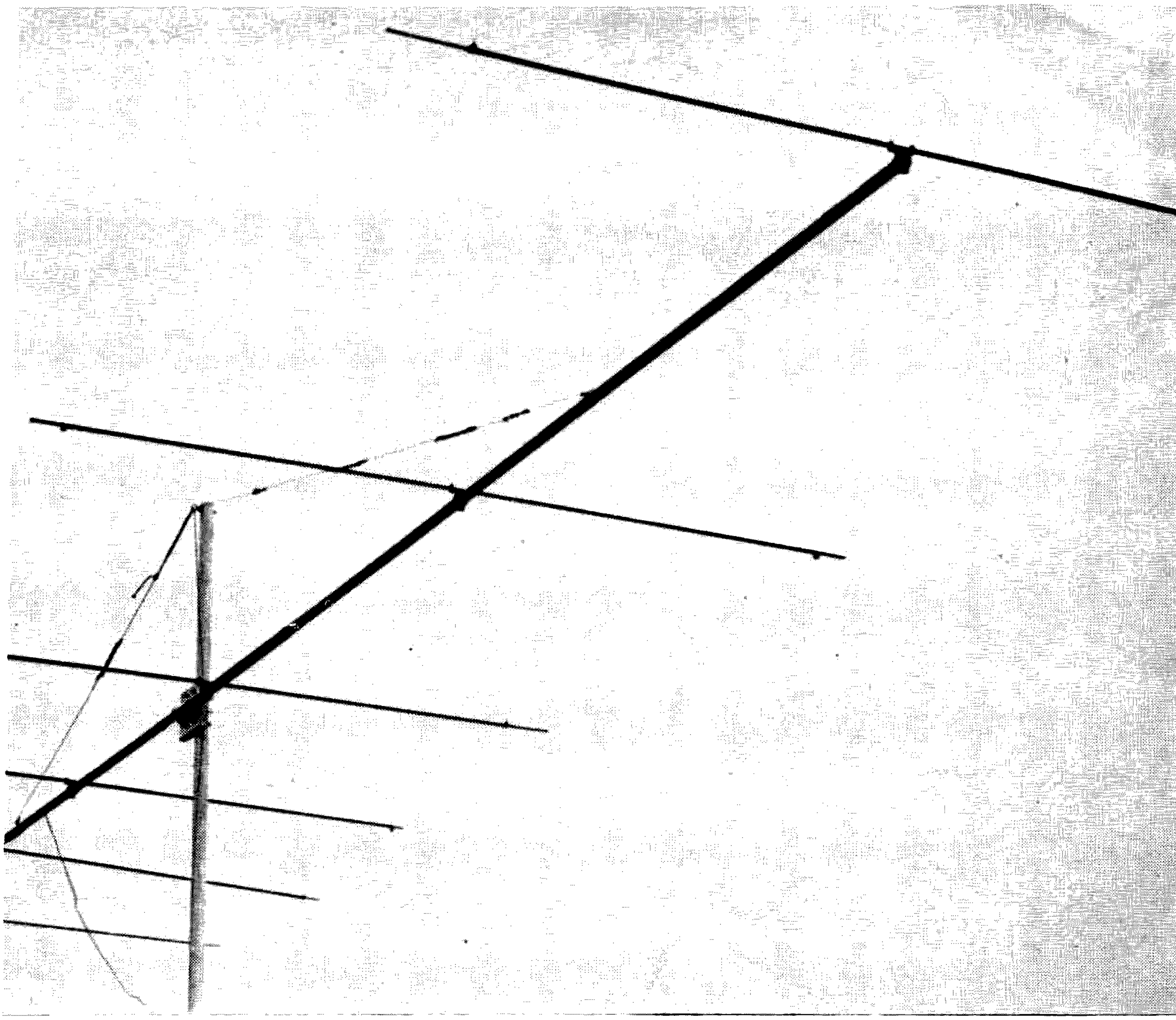
Fig. 1. Dimensions of the six element yagi.

This antenna was built for high gain to provide excellent performance on six. It's a wide spaced six element yagi on a 24 foot boom. It's made of aluminum for lightness, low cost and easy construction. The SWR is excellent over the most used part of the band.

Each element is about a half wave long. The exact length can best be found by experimenting. The distance between the elements can also be adjusted for best results, a compromise between gain, side lobes, front-to-back ratio, SWR, etc. The dimensions given worked very well for me and are a good starting point.

Unfortunately, 24 foot aluminum poles for the boom are hard to find. I used two twelve foot 1¼ inch 0.058 wall poles and butted them together with an eight foot 1⅛ inch dowel in the center furnishing strength. A short piece of 1⅜ inch tubing over the joint gives electrical continuity.

The elements are held on with Cesco Large Yagi Clamps. If you can't locate them, you might try improvising from broken TV antennas, etc. I made each element a little short and slid a length of ⅝ inch tubing in each end for accurate adjustment of length.



A wide spaced antenna such as this one has a fairly high feed impedance—at least compared to close spaced beams. There are a number of different matching systems that you can use. I used the Infinite Impedance Antenna Match which was described by W6NAT in the March 1963 issue of 73. It's very simple.

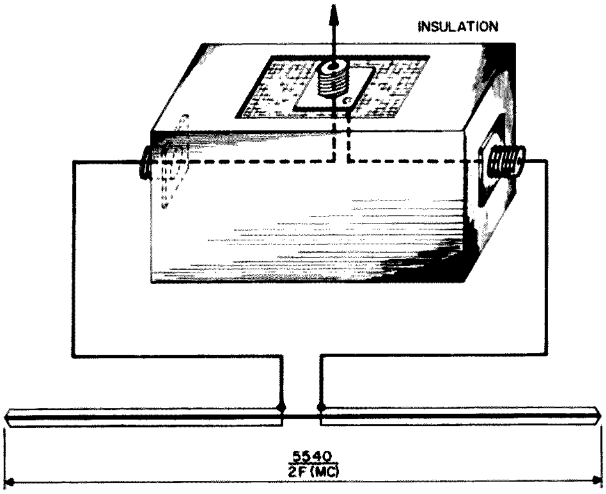


Fig. 2. Matching system.

Take a quarter wave length of RG-58/U. Find its center. Remove one inch of insulation at the center. Carefully cut the shield apart, but leave the insulation and center conductor intact. Gather the pieces of shield together and connect a coax connector to them with the center connector going to one side and the outside to the other. Tape the joint. Now short each end of the quarterwave and tape. This quarterwave dipole goes inside the driven element, which is cut in half and insulated from the boom with a piece of plastic. Notice that there is no direct connection to the driven element.

Mount the antenna at its center of balance with a home-brew wooden mast mount or with a Cesco mount. I added two wire supports from above the antenna to the boom to prevent sag. Break these cables with egg insulators to prevent unwanted resonances messing up the pattern of the beam.

Adjust the element lengths for minimum SWR and you're ready to go. I'm sure that you'll be pleased with the excellent results and long life of this antenna.

. . . WB2CQM

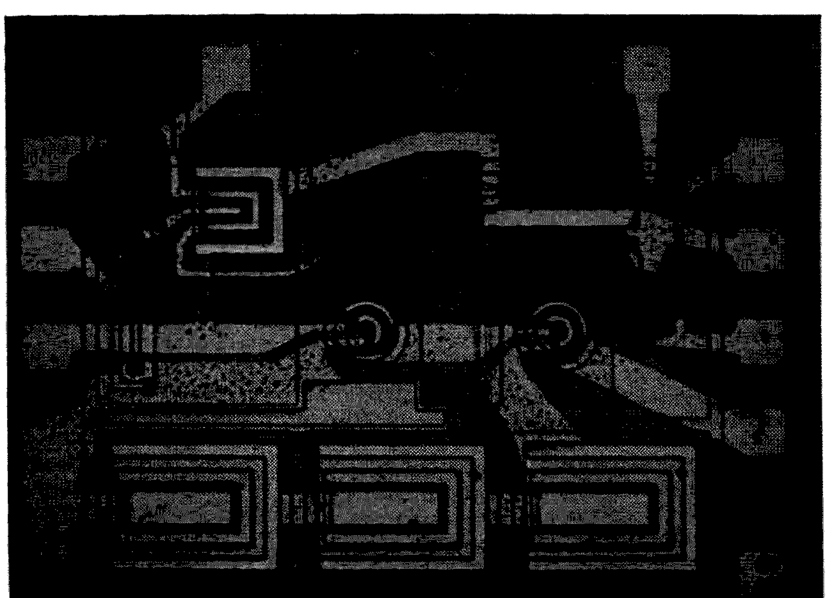
John Specialny W3HIX
728 East Broad Street
Quakerstown, Pa. 18951

A State-of-the-Art Converter

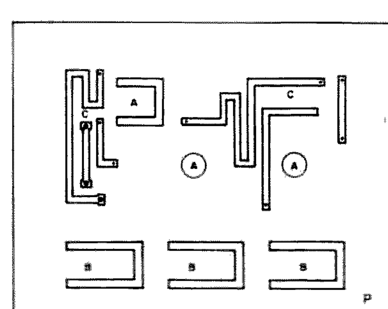
The ham who wants to keep abreast of new developments and uses of semiconductors will find this converter interesting—though the cost is likely to discourage any desire to build it. This six meter converter uses three Philco PA713 silicon integrated microcircuits. It consumes about 66 mw at 6 volts and provides a 7 mc *if* output. Overall power gain is 40 db and the noise figure is a not-to-outstanding 7 db.

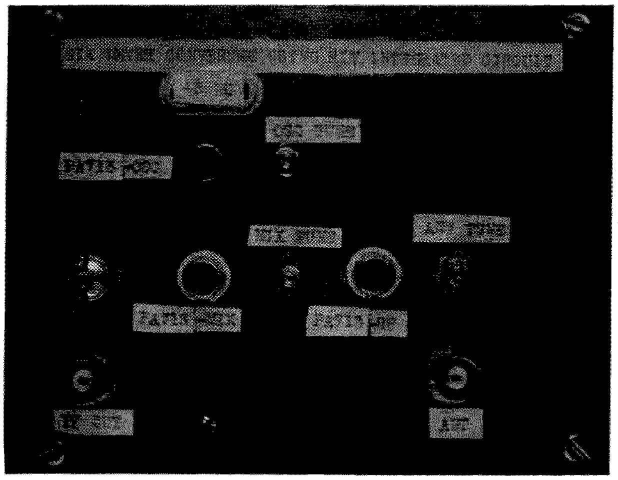
An integrated circuit is a circuit which has its passive and active components combined in a thin block of single-crystal silicon. The circuit components (resistors, transistors and diodes in the case of the PA713) are formed in the silicon by correct programming of p-type and n-type impurity diffusions. This programming includes the use of silicon dioxide (SiO_2) as a mask for controlling the geometry of components. SiO_2 is easily formed on the surface of silicon by high temperature oxidation techniques. In areas where diffusion of an impurity is desired, the oxide mask is removed by a photoengraving process. Narrow p-n junction channels surrounding the circuit components are formed simultaneously with the fabrication of the components. Proper biasing of these p-n junction channels achieves the required electrical isolation of components. Many microcircuits are fabricated simultaneously on a single silicon wafer of 1" to 1½" diameter and then separated into individual circuit chips.

The PA713 microcircuit is a low power, direct coupled amplifier intended for rf, *if* and video service. The locations of the transistors, diodes and resistors in the photomicrograph are indicated by the letters A, B and C

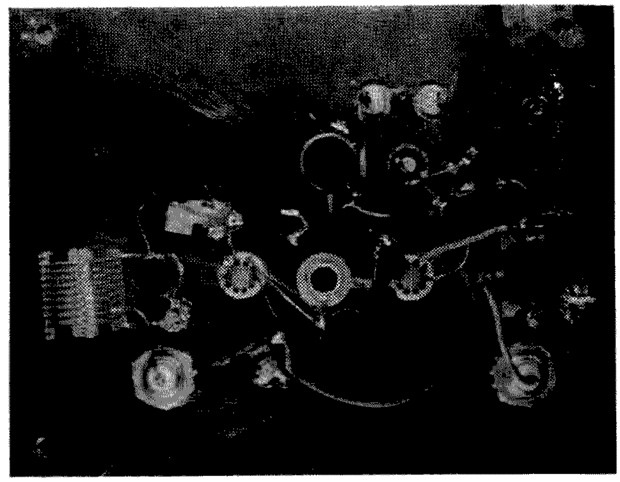


Photomicrograph of the PA713 silicon integrated microcircuit. The drawing below gives the locations of the parts referred to in the text.





Top view of the microcircuit converter.



Bottom view of the converter.

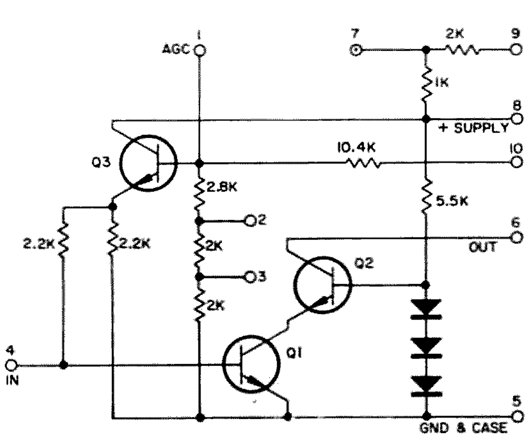
respectively. **Fig. 1.** shows the schematic diagram of the PA713 which is enclosed in a ten lead low profile TO-5 package. The input signal is applied to the base of Q1 through terminal four. Transistors Q1 and Q2 form a cascode circuit capable of about 20 db power gain at 50 mc. Transistor Q3 is an auxiliary emitter follower which provides bias stabilization and bias control. Manual or automatic gain control can be applied through terminal one. The biasing network consists of nine resistors and three diodes.

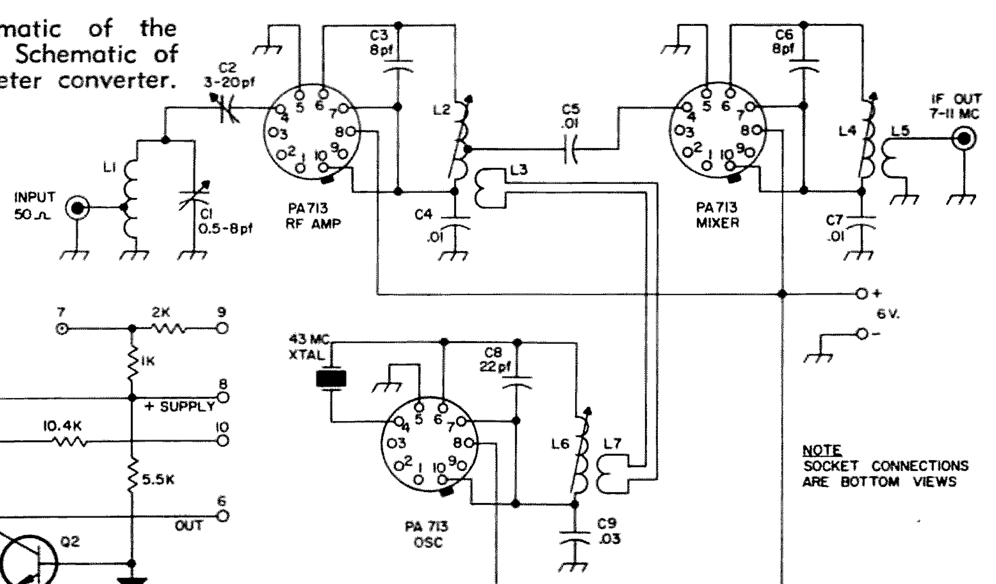
Fig. 2 shows the interconnection of three PA713 microcircuits with discrete components to form the six meter converter. The 50 ohm source impedance is matched to the input of the PA713 rf amplifier by the tap on L1 and adjustment of C2. C1 and L1 form the tuned input circuit. L2 and C3 form the output tank. The tap on L2 provides a low impedance feed to the input of the second PA713 microcircuit used in the mixer stage.

The third PA713 microcircuit is used as a crystal controlled 43 mc oscillator. L6 and C8 form the oscillator tank circuit which is link coupled to provide the necessary injection to the mixer. The 7 mc *if* output is obtained at terminal six of the PA713 mixer. The mixer output tank consists of L4 and C6. L5 is mutually coupled to L4 and provides a low impedance output intended for connection to a communications receiver capable of tuning 7 to 11 mc.

As I said before, this is an interesting project, yet impractical for most hams at present. But in the not-too-distant future, we may see microcircuits in ham gear because of their compactness and uniformity. . . W3HIX

Below. Fig. 1. Schematic of the PA713. Right. Fig. 2. Schematic of the microcircuit six meter converter.





Sylvia Margolis

Hamfest Out on a Limb

To us they looked like Americans—crewcut, iced coke, T-bone steaks—the lot. They talked like Americans and the hospitality they gave us could have originated only in God's own country. The gear was American, lush Collins, slick Johnson, snazzy Drake. The names were American—Bill, Scotty, Ray, Chuck. As for the dinner—who in Germany BUT Americans would serve thick slices of roast beef WITH fried chicken at the same meal? And on a patio too, already!

Yet the Daves and the Franks and the Toms had one bitter complaint. "O.K. So we're Americans with DL calls. But as far as the ham publications go we might as well be foreigners. Nobody wants to know what or how we are doing!"

True, it was only a chance snippet in the British ham press that drew us to Heidelberg for the Fourth Annual DL4/DL5 Hamfest. On vacation in Europe from our home near London, we planned to take in this little bit of the U.S.A. as part of the trip. We'd sent them a wire from our previous campsite, 70 miles away, but were not certain that it would be delivered in time, so there was no surety that we were expected.

Because no reciprocity exists yet between Britain, Germany and the U.S., we had had to strip the mobile gear out of the car. The most glamorous woman caught without her girdle wouldn't know the extent of that caught-with-your-pants-down embarrassment of the keen mobile who is forced to go naked, so to speak! Roll on reciprocity.

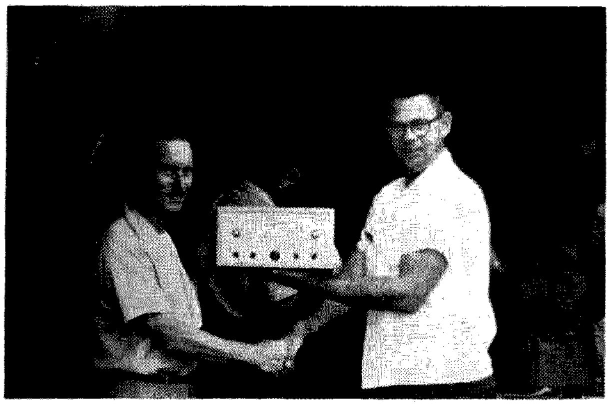
a) Group of DL4/5's at the Hamfest dinner, held at the NCOs' Club at Patrick Henry Village August 3. Group includes DL4BS, DL4ZY, DL4YM, DL4ZD, DL5GV.

b) DJØBS, Bill Symons, at the DL4/5 Hamfest. Bill is Chief Engineer of Radio Free Europe.

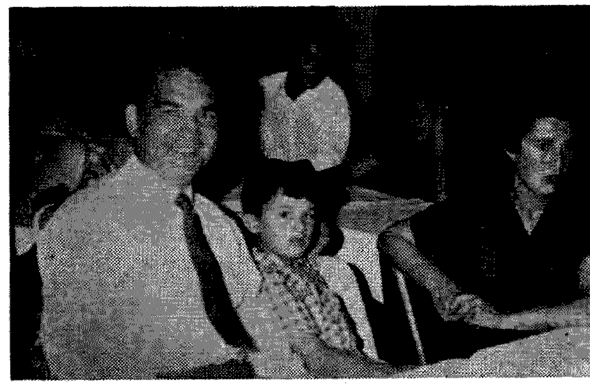
We arrived at noon, in 95° of heat. Pulling the housetrailer in the Friday chaos on the autobahn, with two hot, sticky children enquiring punctually every five minutes how far it was to the nearest ice cream, isn't the easiest way of spending an August day. So it was with some trepidation that we swung off the turnpike, onto the quiet roads of Patrick Henry Village. We had seen a big beam and made for it like homing pigeons.

Patrick Henry Village lies at the side of the autobahn, just north of Heidelberg, on a hot, flat plain, with mountains shimmering in the distance. Gaunt rows of what turn out to be luxurious apartments stretch for acres along avenues with nostalgic names—North Gettysburg, Lexington, Alamo. In the center is a village green, with cinema, school, bowling alley, theater, a fine inter-denominational church, shops, clubs and the Community Center. On this last building was erected the sixty foot high beam and here the hamfest was to take place.

Three hundred yards away the autobahn traffic roared and blustered and screeched and smashed its way between Munich and the north. But this was American territory in every respect and it was into America that we British



c) Scotty, DL4ZD, organizer of the Hamfest, presenting one of the prizes.



d) The author, extreme right, with her husband, G3NMR, and family.

had penetrated with brash, wide-eyed optimism.

A dozen men were putting up tents and unpacking ham equipment. Twelve pairs of eyes focussed on us in unspoken challenge, much as the eyes of the local Indians (or was it turkeys?) must have met those of the Pilgrim Fathers. Come to think of it, they were British pioneers too, so who were we to worry?

We switched off the engine and sat there and looked at them in dead silence. Then somebody noticed the British registration plates and realised who we were. They swarmed round us. "Have a coke!" We were home.

Callsigns, greetings, backslappings, reminiscences. With the eternal magic of amateur radio as a link we were able to put faces to voices we had known for years. "How about that, you old buzzard! Why don't you clean up that signal of yours?" and "Still on AM? Get with it, man. Help stamp out carrier!" and all the silly, esoteric nonsense that joins 300,000 of us in a chain of human sympathy throughout the world.

First—where to put the trailer from Friday through Monday? Why not right here? Here? Won't the General mind? Hell, no—you're hams, aren't you? So we dropped anchors, put up our elegant canopy, which we use as a patio for the trailer, tastefully arranged the outdoor furniture to please the General and made a nice pot of tea.

They gaped at us in horror, ceremoniously drinking this fearsome hot brew *with* milk, keeping our stiff upper lips, with the mercury in the late nineties. So had we conquered (and lost) India! But once we had established our British eccentricity, we compromised by making great pots of good English tea, then diluting it with great chunks of good American ice. Eureka! We had discovered that most civilized of American traditions—iced tea. Best of both worlds!

That night we were invited to dinner by Scotty, DL4ZD, the hamfest organizer. Oh that American hospitality! Oh that baked ham! Oh that ice cream! Oh blessed, blessed ham radio!

Next morning the hamfest stations were set up, including two complete Collins rigs, and 36 hours of hamming began. The thermometer climbed. At lunchtime we were handed sandwiches loaded with inch-thick steak, barbecued Hawaiian-Chinese style, by Frank, DL4DM, who comes from those parts.

Came the dusk and girls and men who had been lolling around all day in Bermuda shorts, re-appeared spruced up for the Hamfest Dinner. Relaxed and laughing we strolled over the Village Green to the NCOs' Club, on whose patio the dinner was to be served. By now great black clouds were queing up for their big laugh and it was a race between them and the delicious meal as to who would get down first! The dinner won by a minute or so and we rushed inside the Club to have us a ball.

The Hamfest Station operated all night, in a tremendous storm. I remember waking to hear the rain doing a cha-cha on the trailer roof and thinking, "I hope they've had the sense to lower the tent flaps, so that the gear doesn't get wet. Doesn't matter about the operators. Just look after the rigs!"

This hamfest was no different from scores of amateur radio events all over the world. But the DL4 boys resent strongly this feeling that they are out on a limb, cut off from the rest of American ham activity. An ocean and half a continent lie between them and home, yet they sense that physical distance is not the only obstacle that prevents them from being part of the American radio amateur world. It has taken a purely chance visit by British amateurs to put their hamfest on the map at all.

Isn't this taking isolationism a bit too far?

. . . Sylvia Margolis

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Are 20¢ Transistors Coming?

The 20-cent transistor may not be far off, now that American transistor manufacturers are beginning to compete with European and Japanese imports. In recent months, special lines with many transistor types priced at less than a dollar have been introduced.

The primary market for these inexpensive transistors is the electronic entertainment industry. For example, some economy transistors made by Fairchild are used in the tuner portion of the new GE 9-inch portable TV set.

Although these economy transistors are intended for use by manufacturers, they are also readily obtainable by the average ham. Several interesting devices can be found in this low-cost field. Within the Fairchild line, for example, there are very-low-noise audio amplifiers, a low-noise VHF RF amplifier, and RF power transistors. These transistors come in two case sizes, TY and TZ, similar to TO-18 and TO-5 cases (**Fig.** 1). So far, the Fairchild line, listed in the table, appears to be the only one to include both NPN and PNP silicon transistors. These devices are available through any Fairchild distributor.

The low cost of Fairchild's line is due to three things, an international production system, an unusual type of transistor construction, and the wide tolerances permissible in entertainment devices. The silicon transistor chips are made by the planar process to obtain good high-frequency characteristics and uniformity during volume production. The headers on which these transistor chips will be mounted are made of a black ceramic material and have the emitter, base, and collector leads imbedded in them. These headers and the basic silicon planar transistor chips are shipped to Hong Kong where the actual assembly and testing take place.

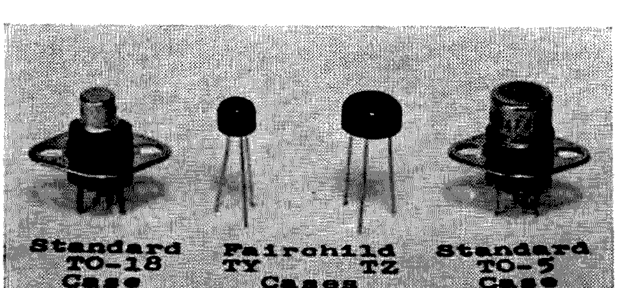


Fig. 1. Size comparison between Fairchild TY and TZ cases and standard TO-18 and TO-5 cases.

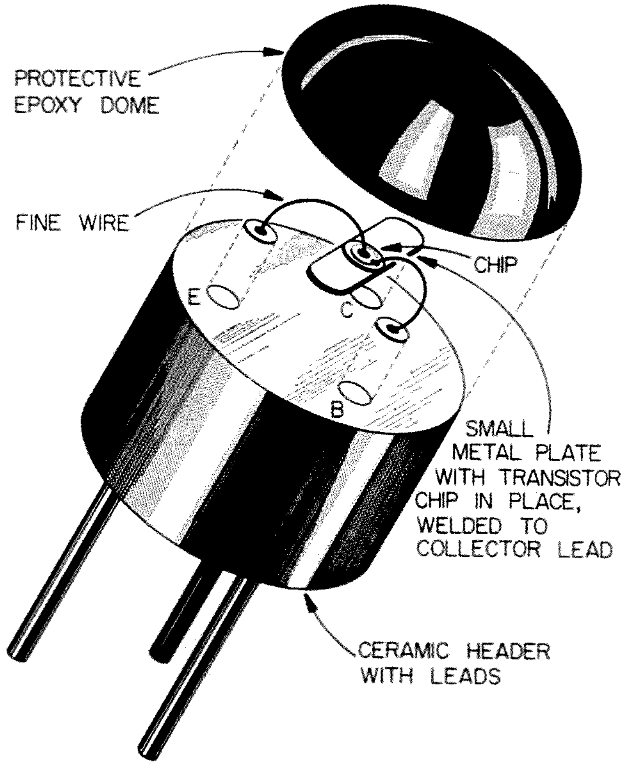


Fig. 2. Construction of Fairchild TY and TZ transistors.

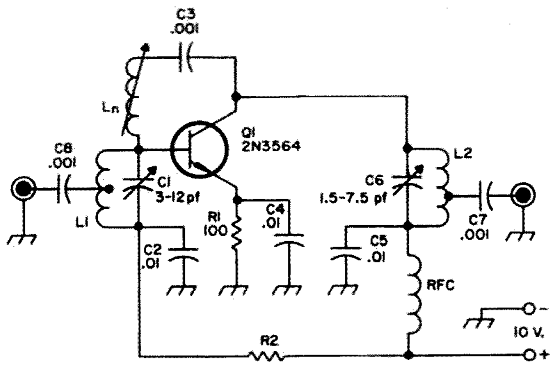


Fig. 3. 200 mc RF amplifier. L1 is 3½ turns no. 16, center tapped, ¼ in. dia., ½ in. long. L2 is 8 turns no. 16, tapped 1 turn from cold end, ⅛ in. dia., ⅞ long. Ln is 0.4 to 0.65 uh. The RFC is an Ohmite Z-220.

In Hong Kong, a transistor chip is first mounted on a small metal plate, and then the plate is mounted on the header surface and spot-welded to the collector lead. Fine wires are then spot-welded to the base and base lead and the emitter and emitter lead. This completes the connections to the transistor chip. The top surface of the assembled transistor is then potted in a shallow dome of black epoxy to protect the chip from mechanical damage. The chip is protected from electrical change by a silicon oxide layer which closely resembles quartz and is formed during the manufacture of the chip. The construction of these transistors is illustrated in Fig. 2. When the completed transistors have been tested, they are returned to the U. S. for quality control checks and sale.

The low-noise VHF RF amplifier transistor mentioned earlier is the 2N3564. Intended as an RF amplifier for transistor TV receivers, it performs well throughout the VHF spectrum, especially at 50 and 144 mc. At these frequencies, Fairchild claims a noise figure of 2 to 3 db. A maximum gain of 25 db is available at 150 mc, decreasing to about 10 db at 500 mc.

Table I

Type	Application	Case	Approx. Cost
2N3563	*if* amplifier to 100 mc, oscillator to 1000 mc. NF at 60 mc = 4 db, P_T = 0.5 w max.	TY	$1.20
2N3564	Low-noise VHF RF amplifier and mixer. NF at 60 mc = 2 to 3 db, P_T = 0.5 w max.	TY	.90
2N3565	High-gain, low-noise audio pre-amplifier. NF at 10 kc = less than 1 db, P_T = 0.5 w max.	TY	.90
2N3566	Audio driver, RF oscillator to 30 mc. P_o at 30 mc = 100 mw, P_T = 0.8 w max.	TZ	1.50
2N3567	High-frequency amplifiers and switches.	TZ	.90
2N3568	h_{fe} at 20 mc = 3, P_T = 0.8 w max.	TZ	1.30
2N3638	PNP high-current switch and audio amplifier. f_T = 200 mc, P_T = 0.7 w max.	TZ	.46
2N3639	PNP *if* amplifiers to 100 mc.	TY	.65
2N3641	Class C RF amplifiers.	TZ	.90
2N3642	f_T = 500 mc, P_o at 30 mc and 15 volts = 1 w, P_T = 0.7 w max.	TZ	.95
2N3640	f_T = 500 mc, P_T = 0.5 w max.	TY	.70

A VHF RF amplifier using the 2N3564 is shown in Fig. 3. At 200 mc it has a gain of 14 to 17 db. for the best noise figure it should be operated with a collector voltage and current of 6 volts and about 1 milliampere, or for the best gain at 10 volts and about 8 milliamperes. This transistor is a good oscillator up to 1000 mc and has been used in experimental UHF TV converters.

Transistor types 2N3641 and 2N3642 are also useful in ham applications. The 2N3641 is used as a 400-milliwatt-output RF driver, and the 2N3642 as a 1-watt-output class C RF power amplifier. Three 2N3642 in parallel can produce 3 watts output at 29 mc with a 15 to 18-volt supply, and 2.25 watts at 13 volts. They should do equally well at 50 mc, as they have an f_T of 500 mc.

A 10-meter transmitter using these two

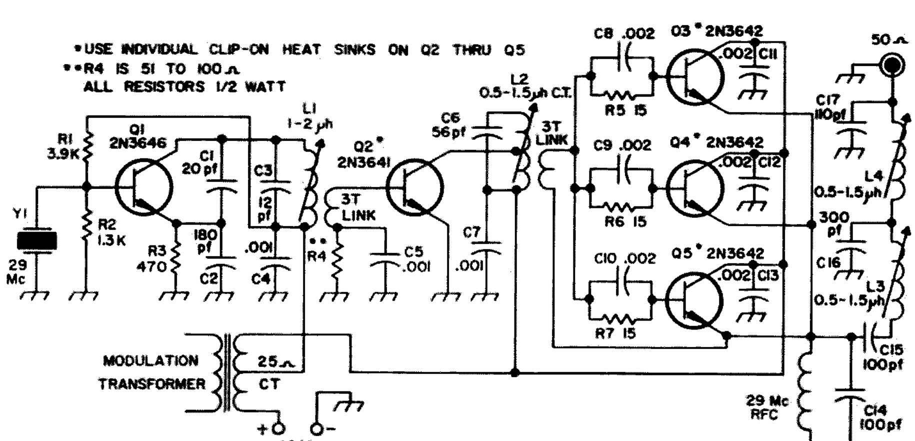
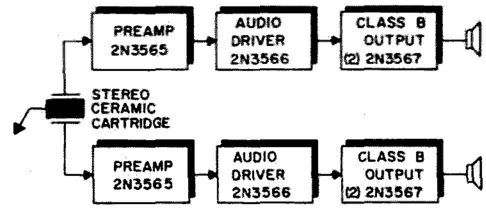
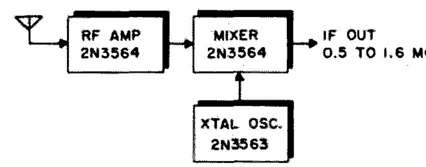


Fig. 4. Three watt output 10 meter transmitter.

A. Shirt-pocket portable AM radio



B. Low-cost 2-watts-per-channel stereo phono amplifier



C. Short-wave crystal-controlled converter

Fig. 5. Possible uses for low cost transistors.

transistors is shown in **Fig. 4**. An alternate to the 2N3642 for use at lower frequencies is the 2N3568. Its capabilities are similar to the 2N3642, except for a slightly higher P_T and a lower f_T.

The ceramic headers used in these transistors do not dissipate heat as efficiently as metal headers, so when these devices are used as power amplifiers, heat sinks are a necessity. They must be of a type which clamps firmly around the perimeter of the transistor, such as those made by Wakefield Engineering. Silicon grease should be used between the transistor and heat sink for maximum heat transfer.

Uses for some of the other devices listed in the table are suggested in the block diagrams of **Fig. 5**.

Transistor prices are definitely coming down, most noticeably in entertainment lines that are not advertised to the general public. The Fairchild line is readily available, as are others, but a little sleuthing may be needed. Generally, it will not be available through the nearest parts house but will have to be obtained from the closest Fairchild distributor. A look in the Radio Master will usually locate him. However, the little effort involved generally pays off. Who knows, before long you may be buying your transistors for 20 cents apiece.

I would like to thank Fairchild Semiconductor for the information and materials used in this article.

. . . W7SMC/6

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The Lowly Coax Fitting

The old saying—"A chain is no stronger than its weakest link" is doubly true in radio. One minor short circuit, bad component, or poor connection can upset the proper operation of any station. One of these connecting links in our ham station chain that has attracted very little attention and is usually installed as a hurried-up after thought is the lowly coax fitting. Improper installation of this little unit can cause malfunctions in your transmitter that will make you pull your hair out (if you have any). The final tube's face can get red and even stick out its tongue and blow its plate suppressors. The resultant poor signal reports and operations do not stop with the transmitter, but will cause a good receiver to perform like a mediocre one. Endless time and undue expense can be spent in searching in the receiver for a problem that is hidden on the outside.

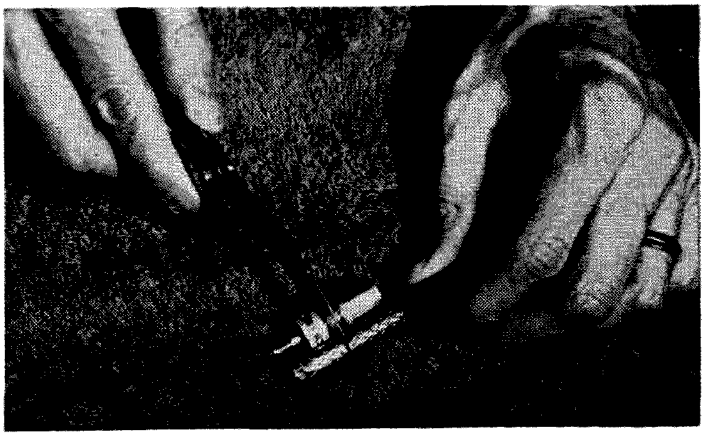
There are many different approaches, techniques or procedures, gimmicks or alternate methods to obtain the end result of marrying the coax cable to a coax fitting. However to avoid confusion a method is presented here that has been used by the author for many years with success every time. The procedure may appear to be more involved than some but I assure you if the following instructions are properly followed a coax connection will never be the source of transmitting or receiving problem.

The Chinese proverb—"A picture is worth a thousand words" is followed here augmented by only a few comments to fill in the background of each photograph.

A length of the vinyl cover equal to the total length of the coax fitting is removed from the cable.

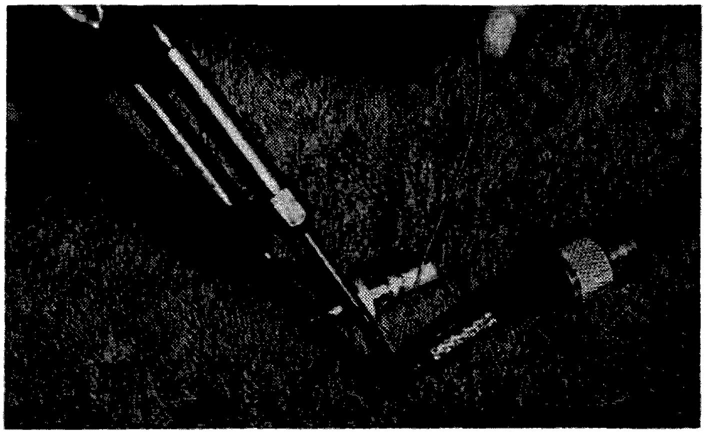
The exposed braid is then tinned very rapidly and thoroughly with a good **hot** iron. A two hundred fifty watt soldering gun is used and performs better than a gun of smaller wattage. The soldering gun is moved back and forth in a smooth, slow movement. Hesitation in any one area is avoided to prevent damage to the polystyrene insulation and possibly shorting the braid to the center conductor.

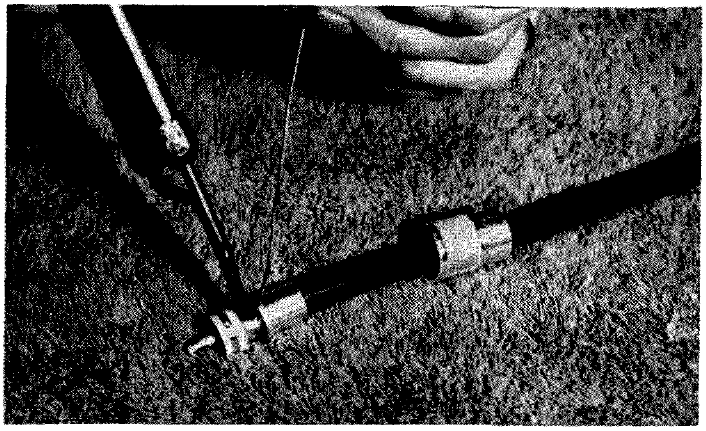
Allow the tinned braid to cool and **scribe** a line around the cable at the location shown in the photo. Do not try to cut completely through the tinned braid, but only scribe a line as shown.



Apply two or three good solid, quick twists to the braid with pliers and it will break with a smooth even edge. Cut through the polystyrene to the center conductor with a slightly dull knife leaving a shoulder of polystyrene approximately 1/16 inch wide.

Tin the center conductor carefully and place the coupling ring on now and facing in the proper direction. It is very embarrassing to complete the assembly and discover the coupling ring has been forgotten.





Place the plug assembly on the prepared coax observing that the tinned braid is covering the soldering holes in the side of the plug assembly. Solder the center conductor first with a clean iron. Allow sufficient time for this job to cool and judiciously apply solder to the soldering holes in the plug assembly. Screw the coupling ring onto the plug assembly and the job is completed.

Always check for possible mistakes with an ohm meter, but if the above procedures are followed and normal care is observed you'll never be caught with your coax fittings down.

. . . W5VOH

Yuri Medinets UB5UG

Expedition to UJ8— 20,000 Feet Up!

Semenov Bashi Mountain

This expedition was organized and completely paid for by Trade Unions. Its goal was quite sportful: to make a high altitude ascent, taking part in a competition Championship of Mountain Climbing (Alpinism) of the U.S.S.R. I took part as a radioman, thanks to my two hobbies—mountaineering and short waves.

For the first leg of the journey we flew to Tashkent (Fig. 1), into terribly hot weather. I visited the local radio club and met UI8KAA, Swetlana, who was operating at the time. The station is badly equipped with a BC-312 receiver in bad condition, and a BC-610 transmitter. The antenna is an ordinary Windom hung low, and a ground Plane. Almost all of the contacts are local; I tried to work from that station, but the reception was poor, and it is no wonder that UI8KAA does not hear our calls (from Kiev).

A few other hams wandered in, but most of them were hurrying to go out of Tashkent ot take part in a Field Day—and that in such awful hot weather! I tried sounding them out about I.H.H.C.*, but most of them were too young, except for UI8AM, a joyful Uzbek, but he lives too far from Tashkent.

In Tashkent I visited an amateur, an old man, who operates a very elaborate station. He has a separate flat, and a separate radio shack (a very rare thing here), and seems to have all the tools and devices one could want. The station is a 200 watt commercial type transmitter, a good receiver with two conversions (very stable commercial type), another receiver: NC-200; the antennas are ordinary: ground plane and a jumble of other poorly understood wires. His cottage is surrounded by greens and looks very nice. This would be an ideal place for the visit of a Ham-Hop guest, but . . . the owner of this tiny cottage and station holds a high post and therefore is reluctant to give attention to IHHC. He knits his brows: his reputation is spotless and he does not want to spoil it.

There are many enthusiastic and well equipped UHF hams in Tashkent. It was a pleasant surprise for me, because I had not realized what UHF radio amateurs could do in Asia with its wide open spaces. On the day I visited they abandoned Tashkent and made their Field Day by sitting in a circle around the city in mountains at a radius of about 250 miles, at an altitude of 11-12,000 feet.

From Tashkent we flew to Osh, the last town before the mountains (Fig. 2). Osh is more colorful than Tashkent, and less Europeanized.

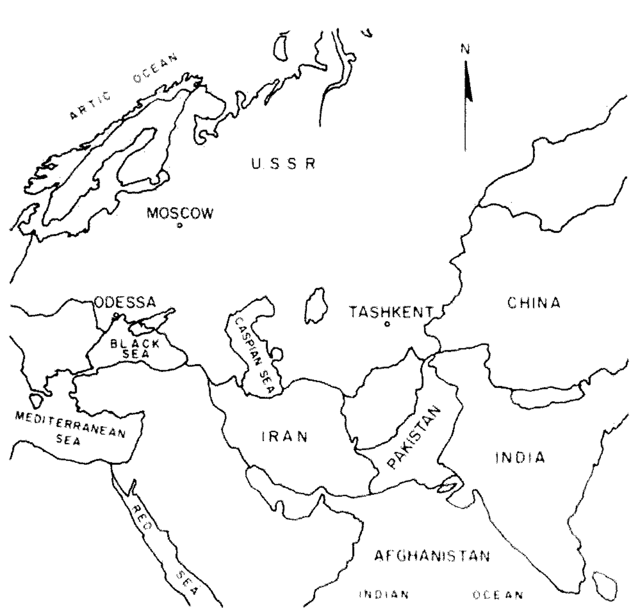


Fig. 1. Location of Tashkent

* I.H.H.C.: The International Ham-Hop Club. This is a non-political organization which arranges travel between radio amateurs of different nations. Headquarters are in Great Britain, and membership extends through 50 countries. Write to G3CED or W4WHN for details.

Yuri UB5UG

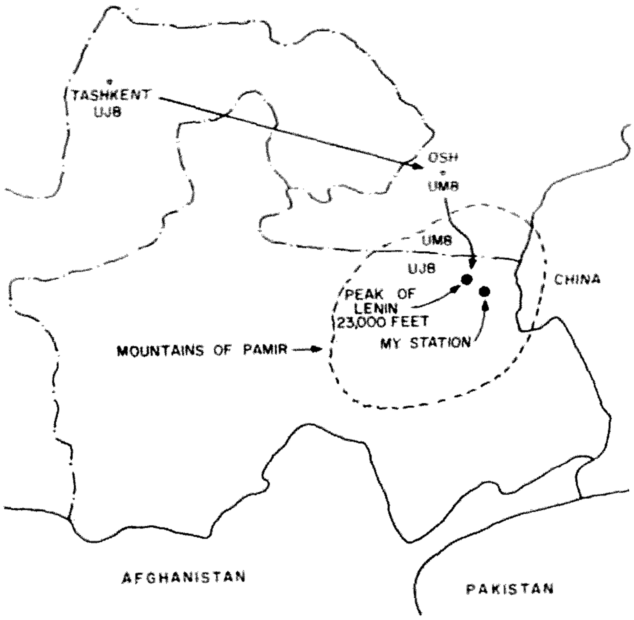


Fig. 2. Area of DX-pedition

Most of the population in Osh are Uzbeks, though the town belongs to Kyrghyzia. Uzbeks are eternal agriculturists and strongly Moslem, at least among the old people. Their culture is interesting; I could write a book about what I saw, and that would leave no space for our amateur activities.

From Osh we got automobiles and carried ourselves and all loads through the mountains: 3 passes to the glacier Oktiabrskv near Lenin Peak, about 200 miles from Osh. We were disturbed when we found that there were no helicopters in Osh, but all went well thanks to the very adequate automobiles "Uralzis" which took us to the Oktiabrsky Glacier, about 12 miles from the Peak. There at an altitude of about 13,000 feet above sea level we built a base camp. Pamir is very much less pleasant than the Caucasus. There is no grass, to say nothing of trees. There is much grey desert. The grey becomes white, then snow, snow, and more snow at 18-20,000 feet. All of mountaineering consists of hard work; someone has said that alpinism is the carrying of big loads to long distances at high altitudes, and without much necessity . . . . The aim of our expedition was to climb to Lenin Peak at Pamir (Fig. 2). It is the third highest mountain in the U.S.S.R.

Other than the main team of climbers, there were the serving personnel—a cook, a doctor, a radioman (me) and so forth . . . . In addition there was one YL from Kharkov, the official delegate from the Sports Society—but more about her later. The various jobs fitted oddly on some of us. For example, Nicolai the cook, is the chief scientist of the Botanical Institute of Kiev . . . When I asked him what he had in common with cookery, he replied that he likes very much to eat . . . Although he is a bachelor and had never cooked much before, to our surprise he did very well—perhaps because of his Hungarian descent. We complained only that there were too many peppers in the meals!

In the beginning, the Ukrainian Federation of Alpinism had made a weighty decision in preparing for this trip: don't take women on the expedition. They figured that the work would be too hard for women. Therefore it was with considerable consternation that we spotted four YLs in the group from Kharkov. All our beggings and threats did not help, and we had to take them with us. The fact is that the girls were plenty strong, and 3 of them made it to the summit. That is pretty good if you take into account the fact that there are only 10 women in the U.S.S.R. (and maybe 15-18 in the whole world) who have climbed higher than 20,000 feet . . . . The fourth YL, Valia, had a lion's body and a lamb's soul, and helped us in base camp. Usually she did something in the kitchen with, and even instead of Nicolai, but when my voice sounded at the microphone, she

Cottage we stayed in

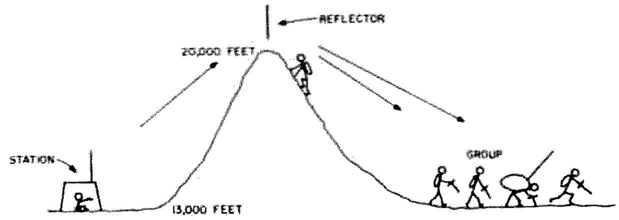
A parasitic reflector

bounded along and sat beside me with open mouth, catching my every word.

For the radio installation, I built a box from wood, covered it with two tents, locked it with guys, and installed my station into the "shack". There was an old aircraft Tx reconstructed and completed with SSB (813 in the final), the receiver was the RCA AR-88, and a home made high voltage rectifier unit. The antenna was a ground plane made from aluminum tubing which we had carried strapped right to the fusilage of the airplane. The whole station was powered by a gasoline motor generator.

I had never touched a power supply like that before, and therefore fell into the top of delight when I heard it working. From time to time I had to repair it. I do not understand anything about such motors, I separated all possible parts every time and then put them together. In spite of some extra parts left over after such experiments, the motor was always working.

Sometimes the equipment went bad, but we got it repaired one way or the other. My first contact was with UM8KAA who came in 5 and 9+. Then a 5Z3 went bad from vibration suffered in travelling. I replaced it by a few germanium diodes, but lost the SSB mode of operation. To make things worse I could not contact Osh during the first days. Well, finally I contacted a VU who called a UA3 station for me, and that ham sent a telegram to our base in Osh: "we need a 5Z3—urgently". The next auto caravan carried the tube to me, and I finally appeared on SSB. The boys were very happy, and I gave the country to many



Reflecting system used to extend our range

of them. Unfortunately, conditions were bad. Nothing was heard from Western Europe for most of the time. And only 6 hams from the U.S.A. are in my log for the whole two months. Three of them were caught the last day (all W5s) when an unexpected opening occurred. Operation was closed by lack of time at my end.

Instead of the W's coming in well enough to contact, I contacted a lot of Japanese hams. Every day I heard signals from the Pacific. Lots of KR6, KX6, KM6, etc. But I have to say that these hams seemed to be entirely deaf. They all use good equipment (S-lines, etc.) and all the time chatted between themselves. To break them it is needed to be +10 db over S-9. Sorry, but I could not put in such a signal from the Pamir Mountains.

The operation of the Japanese was very different. They were very kind, sensitive, and responsible DXers. And despite their low watts, it was always very easy to contact them. There in the mountains I found an extremely low noise level, and that helped.

Amateur radio had occasion to help us with various kinds of information. At one time I called W2PTQ/MM but as usual he did not hear. Then Raju, VU2NR called him and said "that is station UB5UG/UJ8, where two British mountaineers died." Immediately I cried out "Who died? What do you know about British mountaineers??!". Raju replied that he had read a newspaper today and knew that W. Noys and R. Smith from the Anglo-Soviet expedition had died on the ascent (our expedition was about 50 miles from the British one lead by Sir John Hunt. They were climbing the Peak of Communism*). Our fellows were very disturbed, and the questions came fast: when, how, where? But Osh could say nothing; they had not heard anything about it! We all spent a few minutes of silence (which is our habit in such cases), but that helped nothing. Later we found out all about it. When the accident happened, Sir John Hunt flew to Dushambe by helicopter and sent a telegram to England. Poor fellows:

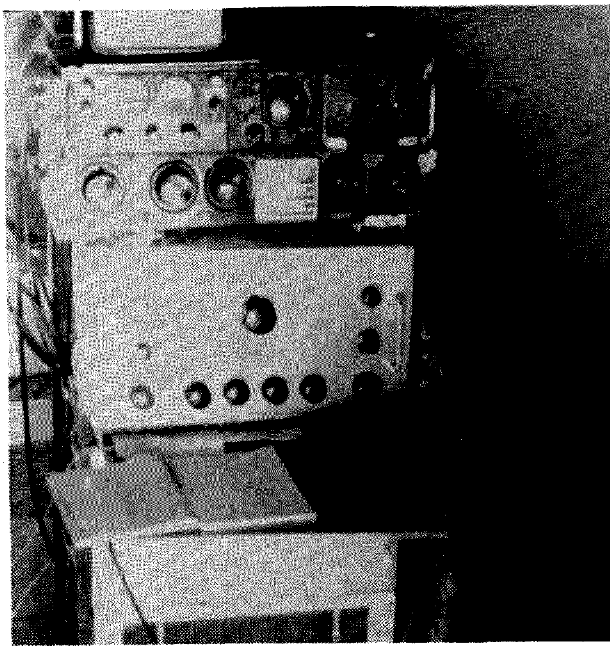
* Formerly Stalin Peak, hi.

they trusted the glacier too much and did not take sufficient precaution.

After a few days of building the camp we began to carry food and equipment along the glacier toward the Peak, about 15 miles from our place, over a pass. The hardest work was to set up the intermediate camps, but they were necessary for the climbing. I carried a 50 pound load without too much difficulty.

My other mountaineering work consisted of setting parasitic reflectors on the main or "ruling" summits to supply an UHF contact with the peak (Fig. 3). The reflectors were half-wave bars or ground planes mounted on wooden poles. The experiment was successful from the point of view of radio, but negative from the mountaineering one: the distance to the Peak was too far for our small walkie-talkies, but the QSO was FB over the mountains for less distance.

As we approached the border region I had a most unpleasant experience. One of our men had accidentally taken with him the papers necessary for our people to come through the border region from Osh. It was necessary for us to get the papers to a certain point by ANY means. This point was 35 miles away, without *any* road or automobile track. What means did we have? Of course, only our feet. I was in better condition than the other fellows at the time, so on an early morning I took these papers and set out through a real grey desert. I went that way for 7 hours without rest. On my way, a small river rushing into the valley (12,000 feet above sea level!) soon disappeared. There remained only stones, stones, and the horns of dead wild sheep. No grass. A few poor flowers (Edelweiss, the flowers of love. Ha!), which I put into my hat. Because of wild animals there (snow tigers, bears, and wolves) I took an ice-axe with me; a rifle would have been too heavy. Through the whole miserable journey I thought about the International Ham-Hop Club, and about our being able to meet your hams. And this pleasure brought a great calm to me and the time passed quickly. Eventually I came upon a road, and stopped a big automobile driven by a Kirghiz. Because of my odd red beard, burned nose, a strange hat with flowers, an ice-axe, and watch showing the wrong (viz. Moscow) time—and my sudden appearance near the State Border, he was very impressed. Undoubtedly I was a spy . . . I begged him to stop when we came to a river, because I had not had any water for 7 hours in the desert, but when I even



The rig I used

moved my leg slightly, he stood on the accelerator; it was important for him to prevent this spy from jumping out on the way. We slid from the mountain pass with the velocity of a falling body. Finally he stopped before a barricade in the road, and a soldier with a gun came out. My driver started to dash from the car, but I jumped out first, shook the hand of the soldier, showed my documents to him, and told my story in a few words. The soldier was very glad to see a mountaineer and he smiled widely. The driver was flabbergasted, and took off as though a demon were on his tail. I gave the papers to the proper authorities, and managed to grab a few hours of sleep . . . My walk back through the long desert is entirely another story again.

I stayed in the base camp while the team climbed the Peak. Though I felt strong enough to climb with them I had to be on the radio every minute; I was the radioman. My correspondent in Osh was a Uzbek YL, Dina with a nice voice. When the team returned I transmitted a pile of telegrams to all the loving girls, wives, and relatives. The usual text was "all our love and kisses, please send 100 rubles to Adler, yours . . . " (Adler is a resort on the Black Sea). Dina worked without dinner. At last, all was finished OK. At the foot of the mountain we loaded 4 automobiles and left for Osh.

We came to Osh dusty and tired. We dove into showers the first thing. You can imagine our pleasure to wash with hot water after two months of washing in ice (and I do mean ice!) cold water. Our faces were burned, and

The start to the peak. YL Alla

because of this we had worn beards. When the gang appeared in a restaurant in the evening, the waiters did not come by for a long time, and the other clients pulled their women close to them. That was a very pleasant party. We invited Dina and her girl friend to take part in it with us.

Aeroplanes took us to hot Tashkent again. We liked Osh very much. Osh has a new good center, broad clean green boulevards, parks, lake, and good public transport. We were impressed by the old town too, though it is small, because none of us had seen it before. I saw that the life of the Asians had been greatly changed for the better since the Revolution. The only question is: has it been done by Communism or by civilization generally? I think the former. To solve it for myself I would have to travel through Iran, India, Afghanistan, and compare.

We left Tashkent the same day. I visited the club and gave QSL cards. On the TU-104 to Moscow I heard English speech and met some Americans from the state of Wisconsin. They were 14-16 years old and very charming. They seriously declared that they would call me from their school ham station; but I did not have the heart to disenchant them with explanations about propagation. Our own fellows asked me to translate "is there black bread in America?", and the American girl asked whether or not any of us had ever been in Michigan or California. My friends and I laughed very much, because it was like asking "have you ever been on the moon?"

So . . . the expedition was over, and we returned safe with a score of about 400 contacts, of all modes, with approximately 50 countries. But the main thing was that we all had a tremendous time.

. . . UB5UG

Many thanks to W6THN/1 for helping to whip this story into shape.

Joe Sport K4QYC
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A Junk Box Power-SWR Meter

As every Ham knows, the antenna is the making of your rig. No matter how much input power you are running to the final, unless you can transfer most of the energy in the output to the antenna, a mediocre signal will be put on the air. Some means is needed to determine whether or not the antenna is doing its job. Many commercially built power and standing wave ratio meters are on the market today, but why buy one of these when you probably have all the parts you need to build one in the old junkbox?

All power/SWR meters are basically the same in that they sample a portion of the forward voltage on the transmission line which can be used to give an indication of power, and also sample a portion of the reflected voltage which is compared to the forward voltage to obtain a standing wave ratio. This author built his own power/SWR meter using parts from the junkbox, and bought only a minibox to build it in (even this would not have been necessary if I had not wanted to dress it up a little). The meter has three positions for reading power—a 10 watt position, a 100 watt position, and a 1000 watt position—and one position for reading the SWR.

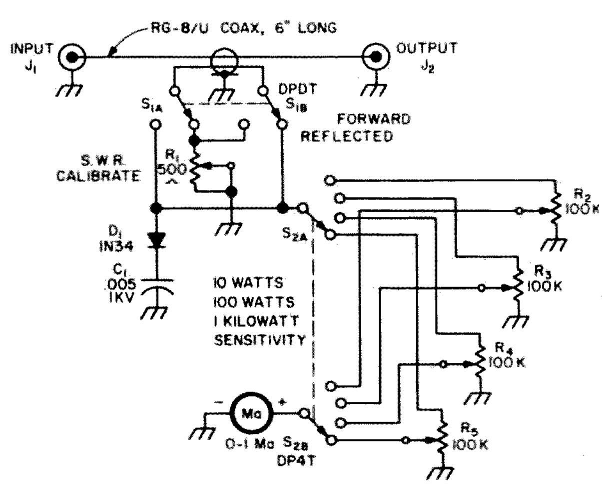


Fig. 1. Schematic of the Junk-Box SWR-Power Meter.

To sample the rf the coupling is made by inserting an insulated piece of hookup wire about 12 inches long between the braided shield and the inner conductor of the coax cable, and bringing it out the opposite end. Each end of the hookup wire is then connected to the proper terminals on switch S-1. To insert the hookup wire in the coax cable, remove the outer cover from the coax cable and push the braid together from the two ends. This will cause it to puff out and loosen. After the wire has been inserted it can be pulled tight again and smoothed out. All other components are connected as shown on the diagram, with the layout depending upon what it is to be assembled on.

As can be seen from the diagram, with switch S2 in the number one position, the upper side of R2 is connected to the rectified rf voltage through S2A1, and the center tap of R2 is connected to the high side (plus side) of the meter through S2B1. Likewise, R3 is connected when S2 is in the number two position, R4 is connected in the same manner when the switch is in its third position, and R5 when it is in the number four position. Switch S1 has only two positions, one to switch in the forward (fwd) voltage for a reading, and the other to switch in the reflected (ref) voltage. Only the forward position is used when reading power, while both positions are used in determining the SWR, as will be explained later.

The parts listed on the schematic diagram are the ones I used because they happened to be available in the junkbox. However, the value of the components used are not too critical, and can easily be substituted if not available. For example, potentiometer R1 may be of any value from about 250 ohms to about 2500 ohms. I just happened to have a 500 ohm pot, so that's what I used. R2, R3, R4, and R5 may be of values from 100k ohms up to 500k ohms, and too, each one can be of a different value within this range as they are all used individually and have no interaction in the circuit. However, I would not use a pot lower than 100k ohms because of possible damage to the meter, and I would not use one higher than 500k ohms because the higher value makes the tuning too critical. The capacitor CI need not necessarily be a .005 but should be something close to this value at 1000 wvdc or higher. The diode D1 could be a 1N48, 1N60, 1N64, 1N66, or some other type and work equally well. Since I had a 1N34 on hand that is what I used. The meter M1 too, might be substituted with a microammeter of some value (although a shunt might be needed) or with another milliammeter of a different range such as an 0-3 ma or an 0-10 ma (however, it might not be possible to get a full scale deflection on a larger meter). As for the switches, it makes no difference what type is used so long as they serve the purpose. SI is a double pole two position switch which could be a rotary switch or possibly two spdt ganged. S2 is a double pole four position switch which could also be a single rotary switch or two sp4t ganged switches, or another combination that would do the job. The Amphenol 83IR connectors are needed, but not absolutely necessary if you have some other means of connecting the input and output that will suffice. The six inch length of RG 8/U coaxial cable could be as long as twelve inches more or less if desired, but a six inch length should do fine. Also, the coax cable could be RG 11/U if a 72 ohm impedance is preferred.

Now, I believe most anybody who has been a Ham for only a short time will have accumulated enough in the junkbox to find most of the parts they will need, especially since the values are no more critical, and allow for a lot of deviation from the author's own construction.

It might be a good idea now to explain how to set the meter up for use. To calibrate for SWR readings, set the fwd-ref switch to the fwd position and the power/SWR switch to the power position. Next, connect the transmitter to the input jack and connect the output to a suitable dummy load if available; if not, you may use your antenna, although its impedance might not be an exact known value which means your reading would probably be a little less accurate than if a dummy load were used (however, it would still be accurate enough for a reference). Next, load the transmitter into the dummy load and adjust the SWR sensitivity control R5 for full deflection on the meter. Then switch the fwd-ref switch to the ref position. If the input and output connections have not been connected in reverse you should now get a lower reading on the meter. R1 should now be adjusted to give a minimum reading on the meter (the meter will probably dip, and this is where you want to leave it). When this has been done the meter is calibrated for reading SWR, and R1 should not be adjusted again.

To use the meter for reading SWR, switch the fwd-ref switch to the fwd position and the power/SWR switch to SWR. With the meter connected in the line between the transmitter and the antenna, turn the transmitter on and adjust the SWR sensitivity control R5 for full scale deflection, then switch the fwd-ref switch to the ref position and take a reading. The SWR can then be calculated from the formula $SWR = \frac{I_{Fwd} + ref}{I_{fwd} - I_{ref}}$. Assuming that the meter used is an 0-1 ma meter, then a full scale deflection would be 1 ma or 1000 microamps, and further assuming that in the ref position you read 200 microamps on the meter, then the SWR would be calculated as follows:

$$SWR = \frac{I_{fwd} + I_{ref}}{I_{fwd} - I_{ref}}$$

$$SWR = \frac{1000 + 200}{1000 - 200}$$

$$SWR = \frac{1200}{800} = 1.5{:}1$$

It might be pointed out here that if a full scale reading cannot be obtained after adjusting R5, then adjust for a half scale or three-quarter scale reading and still use the same formula which will give a relative indication of the SWR which will be fairly close.

To calibrate for power, still using the dum-

my load, set the fwd-ref switch to fwd and the power/SWR switch to the 10 watt position. Using a voltmeter with an rf probe, load the transmitter until you read 22 or 23 volts, then adjust R2 for a full scale deflection on the power meter. Using the E^2/R formula you will find that with a full scale reading you are very close to 10 watts. If other than a 50 ohm dummy load is used then the amount of voltage needed for a 10 watt load can be determined depending on the impedance of the load being used by referring to Ohm's law.

The 100 watt position is calibrated by switching the power/SWR switch to that position and the fwd-ref switch to fwd, and loading the transmitter until 70 or 71 volts can be read on the voltmeter. Then adjust R3 for a full scale reading. In the 100 watt position an rf ammeter can be used instead of a voltmeter, in which case a reading of about 1.35 amps would be needed, calculated from the I^2R formula. Again, these readings are based on a 50 ohm load, and if a load of some other impedance is used, readings may easily be calculated by using either the E^2/R or the I^2R formula. I might add that the rf ammeter could hardly be used in calibrating the 10 watt position as the current would be too low for any sort of an accurate reading.

To calibrate the 1000 watt position the same procedure is used as for the 10 and 100 watt positions. Switch to the 1000 watt position on the power/SWR switch, and to the fwd position on the fwd-ref switch. Load the transmitter until you read between 220 and 225 volts on the voltmeter or about 4.5 amps on the rf ammeter if it is being used. Next adjust R4 for a full scale reading. Once this has been done, all the power reading positions are calibrated and need not be bothered again. To read power all you have to do is switch to the desired position and with the fwd-ref switch in the fwd position, read directly from the meter which can be laid out in divisions to suit yourself.

The question might arise as to how you can calibrate the 100 watt position when your output is only 50 watts, 75 watts, etc., or, how can you calibrate the 1000 watt position when your output is only 150 watts, 300 watts, 500 watts, and etc.? Here you have two alternatives.

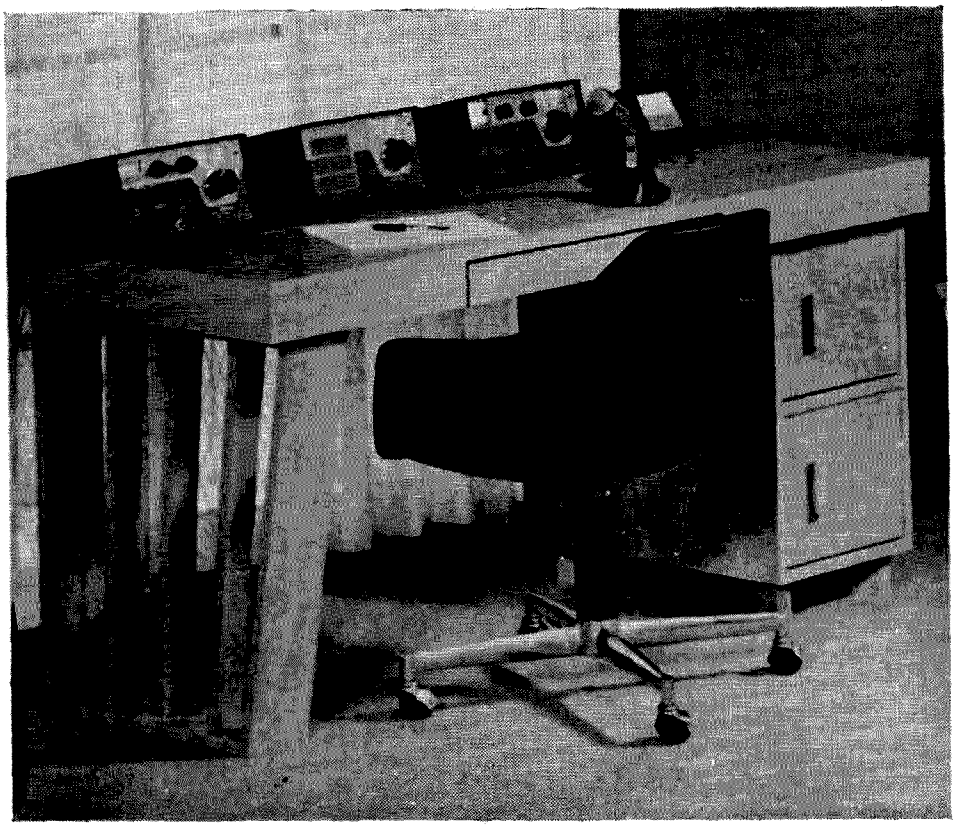
First, since this meter is to be used with your own rig, you can calibrate it to match your transmitter. If your output is 50 watts, then instead of calibrating the meter for 100 watts, simply calibrate it for 50 watts at full scale deflection, or if your transmitter output is 300 watts, then calibrate for 300 watts full scale instead of 1000 watts. The voltage and current values for any given power can be calculated from Ohm's law and the power meter calibrated in any position to read a desired power at full scale.

The second alternative would be to mark the meter off in equal divisions of 10, 5, or whatever you choose. If you have a transmitter capable of delivering 75 watts, figure the voltage or current necessary in order to have a 75 watt output and load your transmitter until you have reached this amount. Next adjust the pot R3 for three-quarter scale reading on the power meter in the 100 watt position and you now have this position calibrated for reading 100 watts full scale or 75 watts at three-quarter full scale, or 50 watts at one-half full scale, and etc. The 10 watt and 1000 watt positions can be calibrated in the same manner if the need arises.

As you might have already seen, in building the meter you could eliminate any of the power reading positions you do not need. If you wanted only one position for reading power, then the other two could be left out of the meter completely, and the one position calibrated to meet your needs.

Once all calibrations have been made, the only control that should ever be adjusted is the SWR sensitivity control R5. With a little practice you will soon be able to get a relative indication of the SWR simply by switching the meter instead of using the formula. The more it is used with different antennas, you can begin to mark off indications on the meter for permanent readings. If calibrated and used correctly, you can get fairly accurate readings of power and SWR with this inexpensive little instrument.

. . . K4QYC



Wayne Green W2NSD

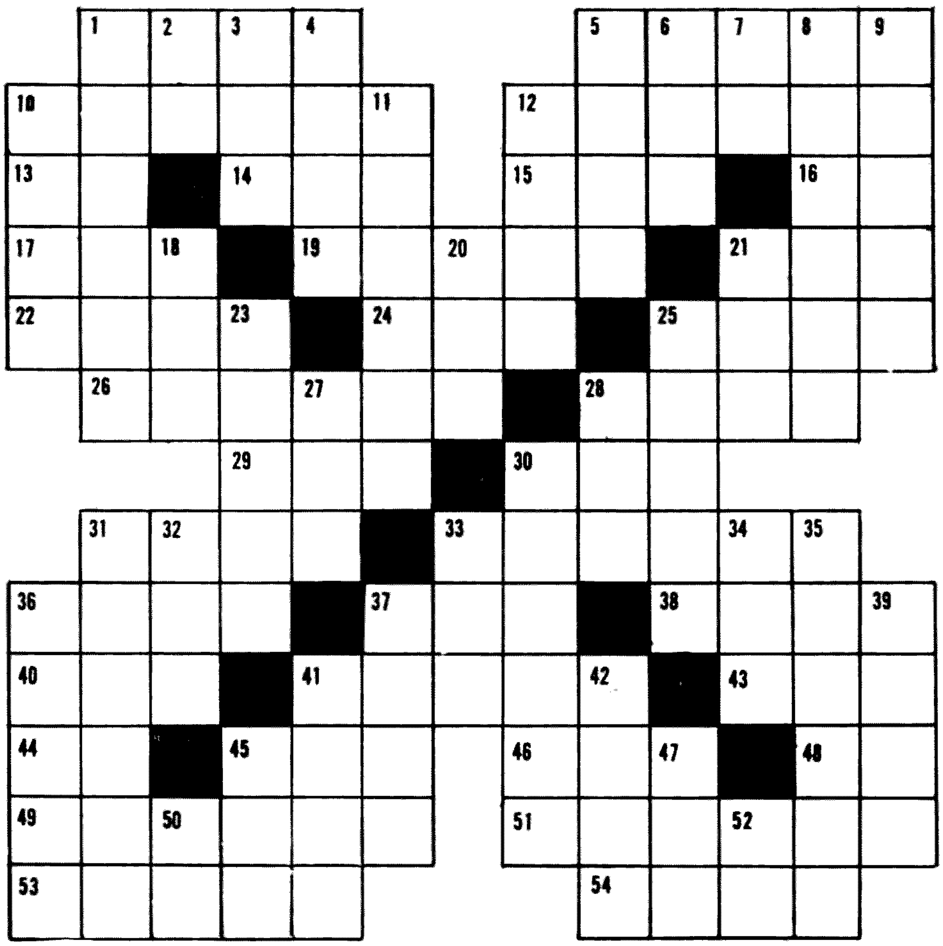
The Design Industries Diplomat

For a long time I have been making do with an ordinary office desk for my operating position. This is OK, I suppose, but now that I've invested in one of the Design Industries Diplomat operating desks I sure do appreciate the improvement.

The Design Industries desk is slanted at the rear so your equipment is directly facing you when you operate, thusly making all dials and knobs easily readable. When I had the rig on the flat desk I had to lean over and squint to see what frequency I was tuning, now it's right there at me.

I've been looking for some time for an operating desk that was well enough made so it would fit in my library and not look like a work bench. This unit serves as both an operating desk and a working desk, plus being a well made piece of furniture which has greatly improved the looks of the whole room. It has two good sized drawers which run smoothly on nylon wheels plus a small middle pencil drawer. The overall length of the desk is 60", the width of the slanted part is 13" and the flat part is 15". There is a cable trough along the back edge for interconnecting wires to keep things neat.

All in all it is a nice piece of workmanship and Design Industries is to be congratulated for making something beautiful and useful available to us for such a reasonable price ($139.95). I suspect that a good many hams who are proud of their stations will be getting these desks. . . . W2NSD



Joseph Gaudet K1CLM
61 Adele Avenue
Haverhill, Massachusetts

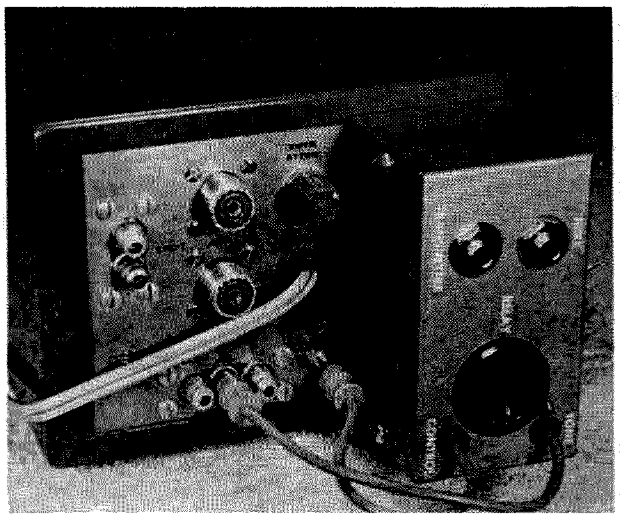
Ham Cross Word

Across

1. Versatile ham meter
5. Measuring instruments
10. Relation between numbers
12. To suit
13. Tibet land
14. Variable resistor
15. Self
16. Power
17. Used with a bolt
19. Points of minimum voltage
21. Wooden pin
22. Day of the week
24. Pronoun
25. What an overheated xfmr can do
26. Control
28. Head coverings
29. Malt beer
30. The OM's XYL
31. Printing measure
33. Not winners
36. LC circuit
37. Sack
38. Eats
40. State in W5
41. Obscure
43. Switch handle
44. 150
45. Animal park
46. Ham record
48. Concerning
49. Type of poetic foot
51. Senior operator
53. Region in OE
54. Receiver control

Down

1. What's in a tube
2. Teletype
3. Wheel



Roy Pafenberg W4WKM
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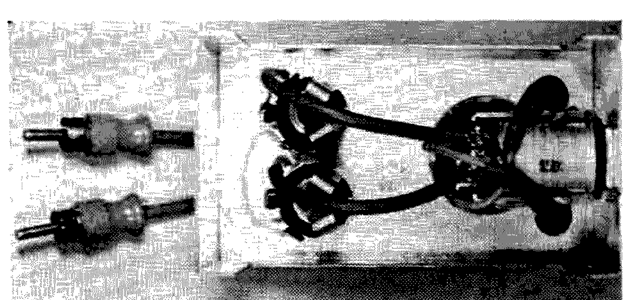
Automating The Two-Tone Test

The quality of your sideband signal is very much dependent on the proper adjustment and operation of your transmitter. Even the best equipment is capable of generating spurious output frequencies and interference if improperly adjusted. By far the best way of insuring the quality of your radiated signal is the use of a monitor oscilloscope. Preferred practice is to use the scope in conjuction with an audio oscillator and injected carrier (or two audio oscillators) for initial adjustments and for routine maintenance checks. Following these tests, the scope should be used to continuously monitor the transmitter output, using either bow-tie or envelope displays. The economical availability of specialized oscilloscopes, such as the Heath HO-10 Monitor Scope, makes it a simple matter to meet these requirements. To further simplify the procedure, the Heath HO-10 contains two audio oscillators for making two-tone tests.

However, even those amateurs who own the requisite equipment conduct the two-tone tests all too seldom. Why? First, you must unplug the mike and patch in the audio tone or tones. Then you must disconnect the antenna from the transmitter and connect the dummy load. Now you are ready for the tests and, after adjustments are completed, you must perform the steps in reverse. Then, if things look different into the antenna, perhaps it would be best to go back and refine the adjustments. At this stage, you say the heck with it, it's close anyway, and you go on the air. Future tests are postponed simply because of the inconvenience of making the two-tone test set-up.

The problem has been stated; now for the answer. This article describes a method of automating the two-tone test. While specifically applicable to the Heath HO-10 Monitor Scope, it may be revised to suit other equipments, including home-brew. In this control system, a control voltage jack is installed on the back of the HO-10. When the TONE GEN switch on the HO-10 Monitor Scope is switched to either the 1 kc or 2 TONE position, an external relay switches out the microphone and connects the tone output from the HO-10 to the input of the transmitter. In addition, another set of relay contacts may be used to switch the output of the transmitter from the antenna to the dummy load. This antenna switching circuit, using a coaxial relay, is entirely conventional and will not be described.

Circuitry of this control system is shown in Fig. 1. Modification of the HO-10 is minor and consists of the installation of one phono jack, one resistor and the changing of a second resistor. Install a tie point under the power transformer mounting screw and install the phono jack as shown. Wire the new resistor as shown in the schematic. Note that resistor



R41 must be changed to a 15,000 ohm, 2 watt unit.

The control relay and the required connectors are mounted in a Bud CU-2103-A Minibox which measures 4" x 2¼" x 2¼". The audio connectors may be of any type you desire although the types specified are compact and allow push-to-talk circuitry to be carried through the control unit. The relay shown in the photograph is a surplus unit. Those without well stocked junk boxes may use a Potter and Brumfield type LM11. Use shielded leads for the wiring. A hi-fi phono type patch cord was cut up and used to wire the unit shown in the photograph.

The control box cover is secured to the back of the HO-10 with the self-tapping screws used to secure the scope in the case. The patch leads from the control box are then connected to the appropriate jacks on the back of the HO-10. Plug your mike into the microphone input jack on the control box and install a shielded cable between the control box output jack and your transmitter mike jack. Now wire a coaxial relay so that when the control box relay closes, the transmitter output is switched from the antenna to a dummy load.

The operating convenience of the control system is out of this world. On the air testing

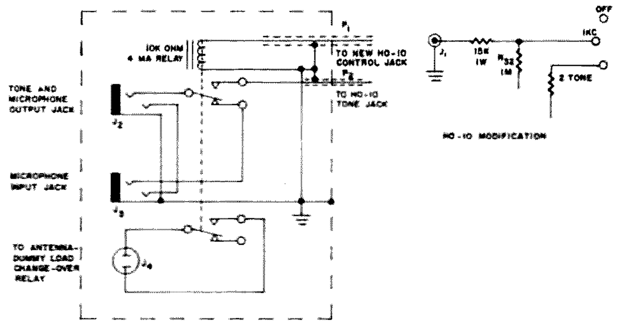


FIG. 1

Parts List
J1—Single hole mount phono jack.
J2, J3—3-conductor microphone jack, Switchcraft C-12B or equal
J4—AC receptacle
P1, P2—Phono plug

is minimized and the dummy load gets the use that it should. While the circuit change in the HO-10 raises the voltage applied to V3 and V4 in the normal operating condition, no adverse results were noted. Also, in the test condition, the voltage on these stages is lowered somewhat with no ill effects.

Relays, particularly surplus units, are cheap. Why throw a multiplicity of switches and make like a one arm paper-hanger when you can automate your station?

. . . W4WKM

Bill Hoisington K1CLL

Two-Meter Solid State Walkie-Talkie Transmitter

Transistors have come a long way since 1950 when I first started to work with them on 75 meter fone. They still burn out at the drop of a pin though. Usually your collector current meter pin! I cured that for the moment by wiring a no. 49 bulb, 2 volts-60 ma, in series with the battery lead. They do work but you've just got to pay more attention to safety. The transistor's that is, not yours. I wound up on this rig with a box of dead soldiers, as usual! Only six this time though. I'll say one thing for them, when you do you get them working right, they do seem likely to work for a long time.

I can see them cutting down size, weight, cost and heat in all TV sets eventually, but that will require loads of very careful work.

When you hike or camp away from that plug or car battery then they become interesting. Even mandatory one might say. Because you are then carrying the power supply, and every dc watt counts. Ever struggle up Slide Mountain (Catskills, 4,000 ft. elevation) toting a car storage battery? I did. Once!

What a deal! Some ambitious soul has edited a book listing "over 3,000 transistors." Let's pick out just one good one and put it on the air. The spec sheet on the one involved, an SYL4221, says "gain-bandwidth product is 850 mc minimum, 1000 typical". Note carefully this is megacycles, not kilocycles.

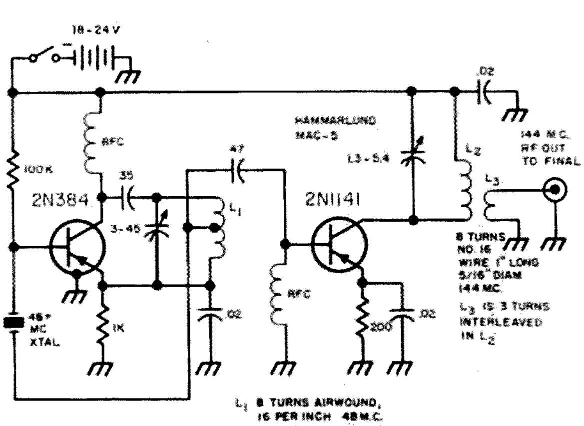


Fig. 1. Two meter driver.

What does this mean? Well, as a comparison, the gain-bandwidth product of the 6AK5, a real red hot WW2 tube, is around 400 mc. This gain-bandwidth business incidentally tells you something about the device. A 6AK5 tube is thus about all through at 400 mc. How then can a transistor beat it? A story of the rf advance of these little solid state miracles since they were invented some 16 years ago will be undertaken later, but only if the facts can be dug out. Around 1953 I lit a bulb on 75 meters with one of them as an rf amplifier. Since then I have watched with great interest their march up towards microwaves.

Several years ago some very large ads came out, like "750 milliwatts 250 mc", and so on. If you read all the fine print in the ad, you found that you could have *either* the 750 mw or the 250 mc. But not both at once! You were "supposed to know" the little dot between those two nice big figures was meant to read "or".

CB has given a boost to 10 meter transmitter type transistors. UHF TV apparently has given the greatest push towards economical UHF types, at least in the low power region.

Other things to remember are prices and db gain. Manufacturers getting 4 db gain with 10 watts out on VHF would crow about it. And charge $80 for one! In fact, in a recent article on rf amplifiers at 144 mc the author (again the honest type) says "The price of the transistors used are out of the reach of

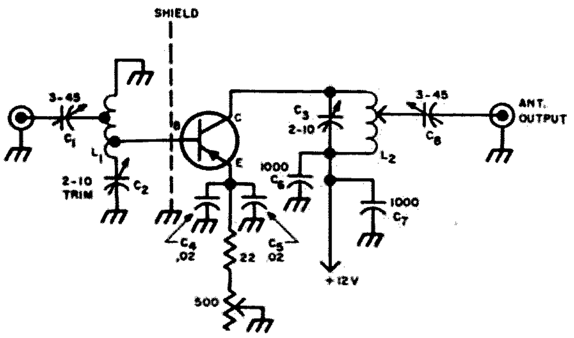
the average amateur, $100 to $200 range." And still with only a few db gain! Watch out for that last one. This is why some circuits show "four 2N— in parallel!" Some of the little ones can be quite good as far as db gain at UHF is concerned. Maybe Uncle Sam (that's you and me) could buy the $200 ones and sometimes he did. If you were in orbit and had to talk back home that's ok. I certainly am willing to help pay my mite to get our brave space cadets down again. But, for the amateur use, too high. The dollars, that is.

Fortunately, as time goes by prices do seem to always drop. That is, for semi-conductor devices. Which is more than you can say for groceries.

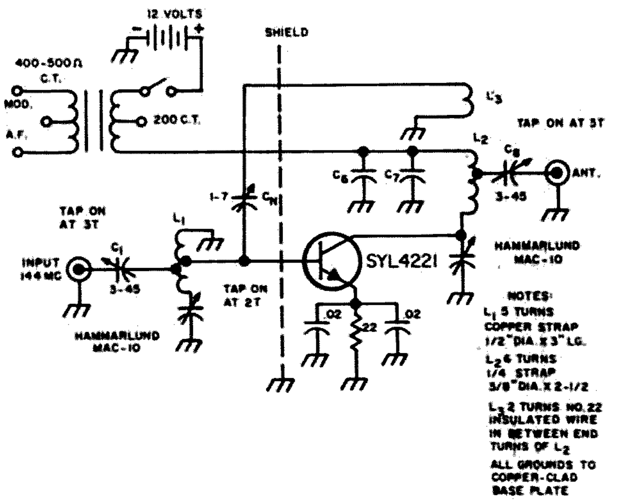
The transmitter to be described below makes use of relatively low-cost transistors now available.

VHF Amplifier Design and Neutralization

You can get a real boot out of this. Practically as many schools of thought as there are writers. Some make no mention whatever of neutralization. Some do. Some speak of unilateralization. Don't let that 17 letter word bother you. It just means that transistors have resistive nuisance feedback as well as capacitive nuisance feedback and you have to "neutralize" both. That's "unilateralization." For



Above. Fig. 2. Trial circuit. Transistor should be shown as NPN. Fight. Fig. 3. Final circuit.



the time being for amateur rigs forget about the resistive part. Be happy if you can neutralize the capacity component.

Now to get to the point. Setting up our good transistor, it's got to be good for two meters because it is listed as a 1000 megacycle amplifier, oscillator to 2000 mc." I started in.

Fig. 1 shows the crystal oscillator and tripler. (Yes, I know I've always advised *doublers,* but you see, this rig is supposed to be low cost, high efficiency, low drain, highly portable, etc.) This is essentially the same circuit as described in a previous article, "A Two Meter Signal Source," but is optimised for maximum output on 144 as an exciter-driver. Until further notice the little transistor with its milliwatt power and low voltage can be considered as not pushing the 48 megacycle rock around. This does not mean you can put in a VHF power job as the oscillator unit with maybe 100 volts and 3 watts. The 48 megacycle crystal might just not like that.

Fig. 2 shows the rf final test set. Note the bare simplicity of it. My first thought was to use an untuned input as shown in most diagrams. Started off OK, base excitation loads up the collector mils, but when I tuned the collector circuit through 2 meters, Zilch! Excitation drops to almost zero and only by a severe amount of fiddling around does the rf output bulb show even the tiniest glow. What about neutralization? So, more study, through a baker's dozen reference books, 73's, CQ's, QST's, Electronic World's and Radio Electronics back to 1958 and the handbooks. Nothing much there on the subject. I did dig up however an actutely interesting piece of information. It seems that present day VHF power transistors aren't good enough to require neutralization! The statement is made that "As high frequency transistor power gains improve it is expected that high gain high frequency power amplifiers will require neutralization". This of course ties in with the above mentioned 4 db gain and the leaving out in some published circuits not only of neutralizing but even any mention of it. Or why it's left out. It also explains why neutralization is required with the transistor shown here. Simply because they are too good not to require it on 2 meters. Live and learn!

That solves for the time being the question of neutralization for this transmitter.

So, for neutralizing first I tried a 2 meter tuned circuit capacity coupled, loosely, between the collector and the base, also trying it between the collector and the hot end of the base circuit. This gave the first real sign of life to the rf output as the 180 degree out of phase energy attempted to cancel out the internal feedback capacity of the transistor. It did work fair, but was touchy, and of course would be strictly a single frequency affair.

After due deliberation I came up with the neutralizing circuit of Fig. 3. At least it works. You can of course see the resemblance to a more or less standard neutralizing circuit. The inductive coupling is low impedance and readily adjustable as to amount, by varying the number of turns, or their placement, or both. It also leaves the rest of the collector circuit as is. It's hard enough to get a decent handling collector circuit on 2 meters without having to put in neutralizing taps, ungrounded tuning capacitors, etc.

So now we have variable inductive coupling for low-impedance neutralizing. The reverse phase is easily obtained by turning this coil over, in case you had it wrong at first. Just remember the old "blooper" rule, with a plate coil and a grid coil wound the same way near each other on the same coil form, put the plate on one end, and the grid on the other. That's for an oscillator with 180 degrees

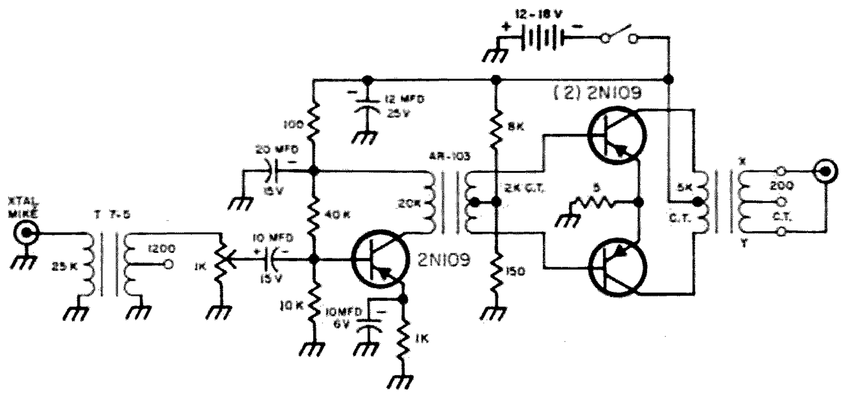


Fig. 4. Modulator.

out of phase grid-plate operation. It is also the way to neutralize if you use just the right amount, in an rf amplifier!

Also remember that more plus voltage on an npn base makes the collector go more negative, like a grid and plate, so the same rules hold for a grounded (or common) emitter stage.

Adjustable low-impedance (simply because it is large) capacity coupling is used over to the base, Cn in Fig. 3. And I think it can be arranged to be quite suitable for 432 megacycles.

With this neutralization the amplifier stage works fine on 2 meters. Lights a no. 49 bulb brightly. Looks almost like quarter watt out. But don't modulte it that way. Tried it out on a little 2 over 2 beam hung on my rotator mast below the 432 14 element Yagi. Carrier went 25 miles or so. QTH here only 100 ft. above sea level. See later tests also.

Note the assorted bypasses on the emitter and collector returns. The 500 ohm variable in the emitter lead can be left out as it stays mostly at zero. The collector mils run between 10 for a 12 volt battery, to 20 miles for a 24 volt battery supply. But, to repeat, do not modulate it that way! Read below what happened when I did.

Note also the copper strap inductance with six turns parallel tuning on 2 meters!

Modulation

This seems to be the same story all over again. RCA handbook has nothing. QST Handbook either. Very few construction articles have much to say about it. I understand that when Raytheon was working on their new all-transistor marine radiotelephone that came out this year they found it very difficult to modulate 100% and had to develop new and patentable modulation circuits for it. Proof enough?

There is one article by a lad who appears to know a lot about it and has done a lot of work on the subject. He first goes in for base modulation, which seems to me like the old grid modulation at first glance, and then he really gets into the business with what he calls "series collector" modulation. This turns out to be a circuit for using the modulator as a variable collector resistor. It requires twice the battery voltage, which he honestly admits, and then he also modultes the driver, which has been required in grounded-grid tube circuits. And the result is "more than 100% modulation!" A form of controlled carrier modulation.

Then what happens? He goes on to say that receivers may not be able to handle this type of modulation. This is where we get off. Mobile and point-to-point services can use special receivers. I've often thought of certain types of special jobs for tests between two amateurs, but this walkie-talkie transmitter is for general use. So, I just hooked up the most economical af design I had using small transformers, with good old collector modulation. (Not that I won't play around with that 150% idea myself later.)

The modulator itself is just straight af work, on which plenty of real good dope is available and published. The problem is just what to do with that audio when you get it. Here, as mentioned, I simply modulated the collector voltage by inserting a modulation transformer in series, like with tubes. And promptly burned out a whole mess of good UHF 2,000 mc transistors. Just so it doesn't happen to you, this is what took place. In trying out various modulation transformers (and transformers, period) some of which had nice labels like "16 ohms", "48 ohms", etc., I assumed that there wouldn't be too much af voltage on such low ohmage secondaries. Was I ever wrong! Incidentally I was using a single large audio transistor and a carbon mic. in this first modulator. (Not shown). The first time I laid the mike down on the bench, Ping!, out went the transistor, shorted out from collector to emitter. Before

I got wise and put my VTVM on the modulation transformer secondary and found as much as 50 volts of af, several more went out! Add that 50 volts to the 24 collector volts dc that I was using, and no wonder. So, too late wise, but still better than never at all, I dropped the collector voltage back down to 12 volts, dc, and kept my eye on the ac modulator voltage before switching on the collector. And while talking also! Since then ok. Just another item about transistor work. Hope it doesn't happen to you. We'll investigate later some 100 volt transistors, with an eye on the price and the gain figure. The little ones described here are only rated at 20 volts, but they work also on 432!

On the Air Tests

As I "tune up" a modulator I listen in on a tuned crystal detector, transistor af amplifier, and earphones, the kind with the big ear pads on them. This is pretty good for a start. You can compare modulation nicely with your regular rig if you have one. Of course, this doesn't tell the whole story. Like FM, overmodulation, etc. It does check reasonable fidelity of speech though, and distortion is heard right away. I have heard plenty of lads with rf-af feedback who should have been listening to their carriers!

The vital check of course, is to go over to a friend's house and "hear yourself as others hear you." The first time I did that I changed modulators in a hurry. The final one shown in Fig. 4 works OK. It also uses quite standard parts and will get you on the air walkie-talkie. On your beam at home it will also surprise the heck out of you and your buddies on the band nearby! It is kind of an eerie effect, going on the air with such a rig for the first time. Someone calls you and you look over your shoulder to see who it might be that he's calling. Soon your confidence grows though, and you're talking like you had 100 watts instead of 100 milliwatts.

I've always maintained that if you can light a bulb you can be he herd. Even though it's only a no. 49, 2 volts at 60 mils.

Reports on modulation run from 75% to "nearly 100%", "clean carrier, no splatter", "modulation excellent", (took that one with a grain of salt). Worked four stations in the first hour, including Weymouth, 21 miles airline, and Billerica, about the same using a small 2 over 2 beam about 35 ft. off the ground. Ground is only 100 ft. elevation above sea-level as mentioned. Receiver (super-het) to match is working; more later on that.

. . . K1CLL

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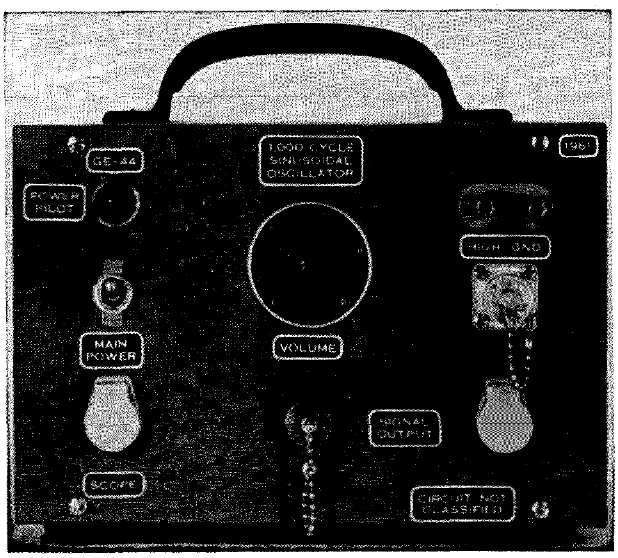
A Reliable Audio Source

No matter how much equipment there is around the ham shack and the experimental laboratory, there always seems to be a need for another audio oscillator for amplifier testing, bridge driving, and filter checking.

"Classical" audio source for these purposes is the General Radio Microphone Hummer, which, within its stated limitations, is a most consistent and satisfactory performer. The writer's instrument, purchased in 1928, finally "went to God" in 1960, necessitating a replacement of some sort.

To make unnecessary the purchase of large high Q inductances, or large variable air capacitors, an RC circuit was decided upon. This family of circuits holds promise of giving satisfactory operation at low cost, low bulk, and low weight. With careful parts arrangement, the probable stability seemed great.

Circuit finally chosen, including power supply, is shown in Fig. 1. Note that this is entirely conventional except for the frequency adjustment, and that all components are "over the counter" items at any distributor's. Although the parts specified are the parts which were used, electrically equivalent parts of other manufacture and the same quality will give substantially identical performance.



Front view of the 1000 cycle oscillator.

Preliminary experimentation with the circuit, which may be described as a cathode-coupled Wein Bridge oscillator, showed that it contained no hidden gremlins. Amplitude stabilization was attained by use of a nonlinear feedback resistor (here a 3 watt, 115 volt lamp) and by regulating the plate supply voltage. This combination makes the circuit insensitive to both slow drifts of line voltage and to switching transients.

For convenience in the laboratory and in the field, the oscillator was constructed with an integral power supply. All components were easily fitted into a standard 5″ by 6″ by 9″ steel utility case, and no "packing factor" difficulties were encountered.

To minimize thermal drift, all major heat-producing components (tubes, lamp, and VR dropping resistor) were mounted above the chassis, which is a 5″ by 8″ by 2″ SeeZak.

Frequency control and other "cold-running" components are mounted under the chassis. The fixed resistors and capacitors in the frequency-determining circuits are kept free of the chassis to insure good air circulation and to minimize heating by conduction. Tie points were used where necessary to support the heavier resistors and capacitors. As no high frequencies are involved, wiring presents no serious problems.

As a precaution against hum injection, filament wires are run as twisted pair, and are dressed around the edges of the chassis.

Ohmite type AB pots are used in this oscilla-

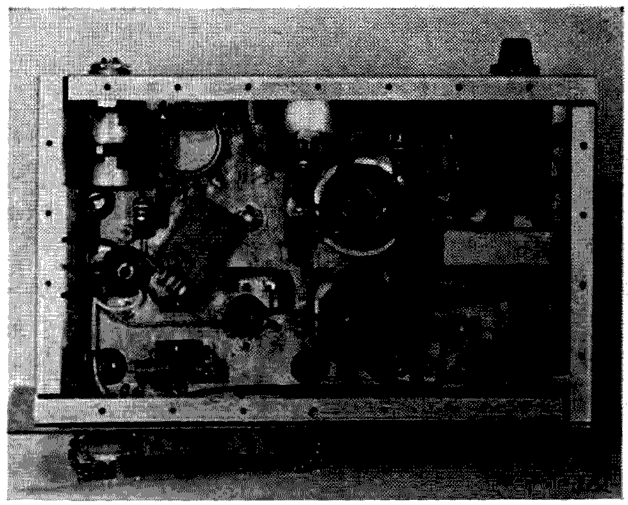
tor wherever a variable resistor is called for. Despite their higher first cost, these pots (or others of equal quality) are strongly recommended, as they will hold their settings indefinitely, and will not break down in this service. Use of the very inexpensive variable resistors designed for ac-dc "kitchen" radios is false economy here.

Power supply is the conventional full-wave center tap circuit, but it is arrived at by use of two small half-wave transformers (Merit P-3046) with primaries parallelled and secondaries connected in series, with the interconnection and furnishing the center tap. To suppress small transients introduced by the "toe" of the silicon rectifier characteristic, a small paper capacitor (0.01 mfd, 600 volt) is shunted across the outside ends of the secondary circuit.

Output circuit appears somewhat unconventional, in that there is a multiplicity of terminals of various sorts. This arrangement is intentional, and is designed to eliminate the need for carrying around a pocketful of adapters. A separate jack is provided for the scope connection.

Adjustment of this oscillator is done in two steps. First, with the chassis out of the cabinet, the oscillator is run for a time to permit rough stabilization, the scope is plugged into the SCOPE jack, and the waveform is brought into sinusoidal form by adjustment of the WAVEFORM control. When the waveform is satisfactory, this control is locked, and the oscillator installed in the cabinet.

After a further period of stabilization, the output is compared with a 1000-cycle standard, and adjusted "right on" by the FREQUENCY control on the rear. By use of a conventional Lissajou comparison, the test oscillator can be set to the same frequency as the standard with an error of less than 1/10 cycle per second. It is also possible to obtain a good frequency setting by means of a linear audio frequency meter, which has recently been aligned with one of the tones from WWV. When the frequency adjustment is satisfactory, the FREQUENCY control is locked in position.



Bottom of the audio oscillator.

If a frequency other than 1000 cycles is desired, this may be obtained by changing the 300 mmfd capacitors (C in Fig. 1) to some other value. The frequency being an *approximate* function of 1/C. Voltage output (rms) is approximately 1.5 into a high impedance load, and can be attenuated to any value down to zero by means of the volume control on the panel.

. . . Ives

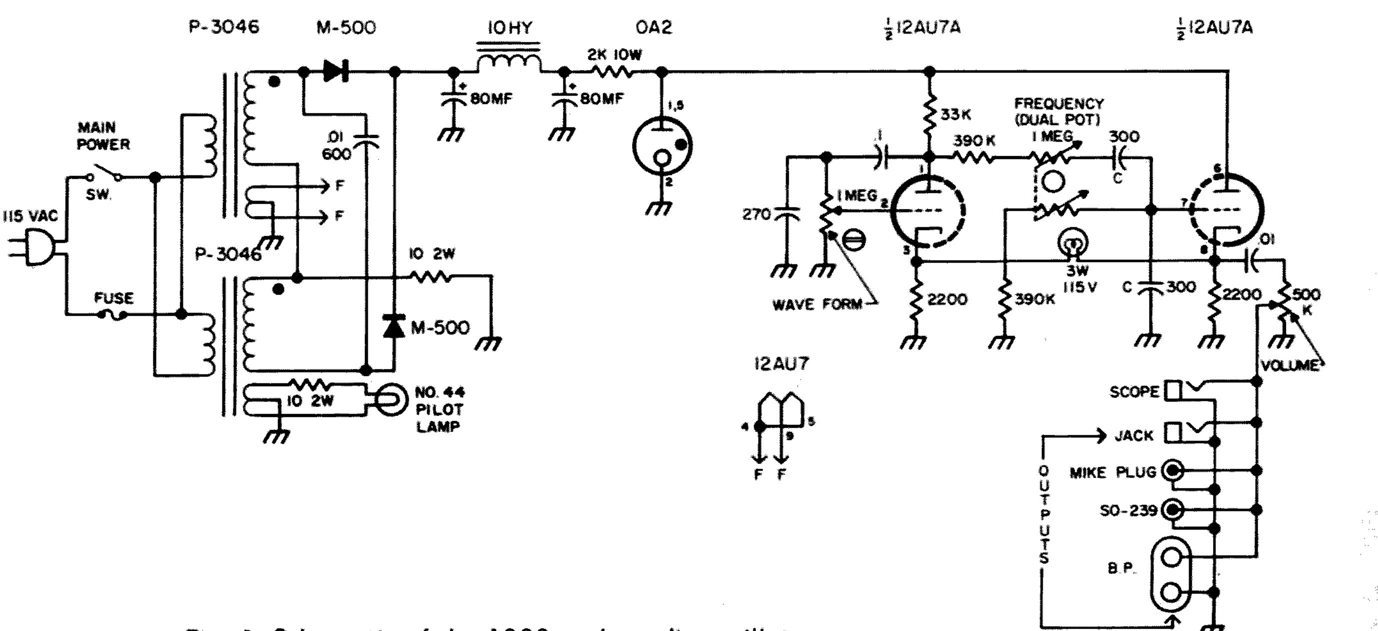


Fig. 1. Schematic of the 1000 cycle audio oscillator.

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Improving the Heath Mohawk

Although it has recently been superceded in the Heath line, there are still many Heathkit model RX-1, "Mohawk" receivers in various ham shacks. It is still an excellent ham receiver, but a few simple modifications will increase its sensitivity and improve its audio quality on SSB.

Pepping up the Front End

The Mohawk uses a 6B6 tube in its rf amplifier stage. However, the tube is prevented from doing the full job it is capable of by the use of a 220 ohm cathode bias resistor instead of the 56 ohm resistor recommended by the tube designers for maximum gain. Reducing the value of the cathode resistor to 56 ohms improves the signal-to-noise ratio a couple of db on 10 and 15 meters. It also increases the receiver gain a trifle, although this is of minor importance.

As the 6BZ6, rf amplifier, 6CS6, mixer, and 12AT7, oscillator tubes are mounted on a preassembled subchassis in the front-end section of the receiver, it looks like a major task to change the 6BZ6 cathode resistance. Actually the job is not difficult. The left side of the chassis on which these tubes are mounted is removable to expose the components connected to the three tube sockets.

To remove the side plate, unscrew the hexhead screws at the front and back of the subchassis. After removing the plate, locate the 220 ohm (red-red-brown), ½ watt resistor connected between pin 2 of the 6BZ6 tube socket and the nearby, insulated terminal strip. Do not attempt to remove the resistor; instead, connect an 82 ohm, ½ watt resistor in parallel with it. This may be done by cutting the leads of the new resistor to a length of approximately ¾", forming a small hook on the end of each wire with long-nose pliers and hooking them on the leads of the original resistor. Naturally, a small soldering iron is helpful in soldering these connections.

Noise-generator measurements indicate a 2 db improvement in the signal-to-noise ratio of the receiver on 10 meters after the change in the 6BZ6 cathode resistor. In practice, extremely weak signals are slightly easier to read than they were before the change. But don't expect to notice any change on strong signals.

Incidentally, if extremely-strong, local signals tend to block the receiver (especially on the lower-frequency amateur bands) after the resistance change, retard the 6BZ6, rf gain control sufficiently to eliminate the blocking while the locals are on the air.

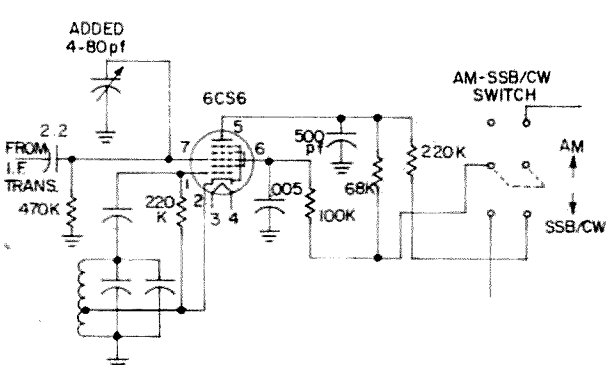


Fig. 1. Changes for improved audio.

Better SSB Quality

The audio quality of the Mohawk receiver leaves something to be desired when receiving SSB signals. The principle cause of this seems to be that, in order to hold down the audio output of the 6CS6 product detector to the same level as from the diode (AM) detector, the 6CS6 is operated with considerably less voltage on its plate than on its screen. Much better audio quality is obtained on SSB if the screen voltage of the 6CS6 product detector is reduced and its plate voltage is increased.

To modify these voltages, disconnect the 68,000 ohm resistor from the screen terminal (pin 6) of the product detector socket. Then, reconnect the resistor to the insulated tie point where the 10,000 ohm resistor (which also goes to the screen terminal) is terminated. Next, replace the 10,000 ohm resistor with a 100,000 ohm, ½ watt resistor.

After these changes are made, the audio output of the product detector will be far too high, until a small capacitor is connected from pin 7 of the product-detector socket to ground to decrease the *if* signal fed into the detector. A 4 to 80 mmfd mica trimmer capacitor, such as the Lafayette C-732 trimmer capacitor, is ideal for the purpose. Adjust it so that there is no change in the volume level from the loudspeaker when the receiver is switched from AM to SSB/CW reception. A 47-50 mmfd fixed capacitor may also be used, if you don't mind touching up the volume control setting a bit when switching modes.

Slowing down the avc action on SSB also improves the receiver's audio quality a bit. This change is simple: connect an additional 0.1 mfd. paper or mylar bypass capacitor in parallel with the original 0.01 mfd capacitor across the avc line. The additional capacitance does not impair avc action for AM.

Taming the Mohawk S Meter

As you Mohawk receiver owners know, the Mohawk S-meter has a tendency to be a mite generous—indicating 40 db over 9 on the lower frequency bands with no signal tuned in, unless the *if* or rf gain control is turned away back. If this generosity bothers you, try substituting a 12AU7 for the 12AT7 in the S-meter/1st audio tube socket. It will have to few db off of the readings. You will have to re-zero the meter with the meter-adjust control, but this takes only a few seconds. Also, with the 12AU7 in the socket, you'll have to advance the audio gain control about five per cent to compensate for the lower gain of the 12AU7 compared to the 12AT7.

. . . W9EGQ

Gus: Part VI

Well, boys, I was at the Radio Prague studio a few minutes before 9 am and was taken in the big fancy studio and seated in front of the mike and told that when the green light came on, I had one minute to get ready to go on the air; that when the red light came on, I was "on the air", to start talking. I am one of those crazy fellows who just don't plan what I am going to say before I start saying it. Here I was and as usual had made no plans at all on what I was going to talk about. But I did make up my mind that if there were any propaganda said into that mike . . . I would be the one to say it . . . and it would be propaganda for me, and not them.

So on came the red light . . . I was on the air. I started something like this, "My name is Gus Browning, and I am from one of the poorest but nicest places in the US, the little state of South Carolina. If you look at a map, you will see that it is one of the smallest states in the US. I am not one of these rich Americans you hear about, I am only just an average American, with 4 children and a nice wife. I have my own business, which is radio sales and service, just a small business which I run myself. As far as the US is concerned, I am sure that they have no idea where I am; in fact, they don't even care where I am. I suppose they feel it's none of their business where I want to go. I decided two years ago I would like to make a trip around the world, so I saved my money and am now on that trip. The radio amateurs here in Prague are treating me very nicely. I think radio amateurs the world over always treat people nice because I think radio amateurs are the finest people in the world." Then I rambled on till my 15 minutes were over. I felt that in my little way I had done a little propaganda for the US, and right over Prague radio. Such remarks as saving enough money to make a trip around the world in 2 years and that I am only an average American and that what I do is my own business were read-between-the-lines propaganda. I figured that listeners would be able to see from that how things were in the US.

One day I was walking down the streets of Prague and out of a clear sky a big Rolls Royce (it looked like one to me) pulled up to the curb and blew its horn. I nearly jumped out of my skin, because I thought maybe he was trying to run me down. A big tall chap stuck his head out the window and said, "Is that Gus Browning, from Orangeburg, South Carolina?" I looked closer at this fellow and said, "Hello, John!" Then I asked him what in the world he was doing here, and his remark was, "The same as you; I wanted to see what's behind the curtain." I hopped into his big fancy car and we got to see lots of Prague together the next couple of days. John had shipped his car to Munich and had driven it to Prague along with his wife and son. John (GW3ZV) had visited me in my home a few years previously, that's why I knew him when he poked his head out of the car. Boy, it's a small world when you meet someone from South Wales in the middle of Prague.

One night I had a telephone call from Harry, over in Bratislava, in the east part of Czech land. He asked me to come over and visit him. I kind of beat around the bush (my money was not too plentiful). He said, "Gus, I will fly over and pick you up and we'll both fly back here together." The next day Harry arrived, bought me an airline ticket and we flew back to Bratislava together. Harry is a doctor and he was a very fine host to me, taking me all around that area, and we met many of the OK3 boys. Harry's call sign is OK3EA, and there is no finer and more friendly fellow in all of Czechoslovakia. Harry bought me my return ticket to Prague. I spent a few days again with Mirek OK1FF and with a very kind feeling towards the Czech boys, I departed from Prague for Munich by train.

The trip was as usual: very crowded train, people standing all over the aisles, good many police here and there . . . then we arrived at

the West German border . . . and customs again. These boys meant business; they were making everyone dump their clothes out of the suitcases and they were searching every pocket in every garment. Then I remembered a badge with a red star on it one of the OK fellows had given me, and had suggested that I wear when leaving the country. I immediately put it on the lapel of my coat. When the customs man got to me, I reached into my inside coat pocket and noticed the customs man glancing at the red star badge on my lapel. I handed him my passport, and pointed to my luggage overhead. He said, "Oh, that's all OK," and without any further remarks to me, proceeded to the next seat, still making everyone dump their suitcases like before. You know, I am still wondering if the red star badge I had on my lapel had anything to do with my suitcase not being dumped and searched. Maybe it was a coincidence he did not give me the big search like everyone else received. Or maybe I had an innocent look on my face, or it may have been my "Auspice Day".

Now, that "Auspice Day" stuff reminds me that in this area of the world (I'm in AC5 land right now) nothing of real importance will be done unless it's your "Auspice Day". One of the Temple (Dzong) priests who understands about the stars, planets, moon, sun, etc. tells them if the day is "auspice" or not . . . don't fool yourself, these people believe him, too, all the way from the lower caste to the very top. Then it seems that they have another sort of "Un-auspice Day" . . . or something like that, which causes them lots of trouble. We've all heard people say, "This is one of my bad days," or maybe, "This is my day to shine." Well, there you go . . . "auspice or un-auspice."

Life here in Bhutan is very interesting. Occasionally I see a Bhutanese or group of Tibetans driving a herd of yaks up one of the mountain passes. Then I see quite a number of Lamas coming or going from the nearest Dzong. At night, I hear those big long Tibetan horns blowing, and some of those horns are about twelve feet long and it takes three or four men to hold it up when it's being blown. These are the most peaceful people I have ever seen.

I had just found out about Bhutan's biggest religious celebration that's held each year over in Paro at the Paro Dzong. I was asked if I would like to go over there and witness this big celebration. I, of course, said yes. (I was thinking about that being the AC6 portion of the country too!) So on Monday we packed up the Jeep. Now, over here when you go from one place to another, you just don't hop

you have to take under consideration. You take ALL your food, your bedding (mattresses and all), you take your own cook and bearer (this bearer is a sort of all-round servant), and of course you take your radio gear, power plant, antenna. I also invited my good friend Mani Kumar (the radio technician at Dechen-Cholling) who is my constant companion and a real nice fellow. You try to picture us, four people and all their bedding, food, and radio junk all to be carried in one small Jeep. When all that stuff was out on the ground, it was a very big stack and to me looked absolutely impossible that all of this, plus four people, could go on a Jeep. Well, after a lot of juggling, repacking, and cramming, we got it all inside the Jeep and away we went.

The acting Signal Officer at Dechen-Cholling had sent a radiogram to the Signal Officer at Paro to take care of us, and let me tell you, we really were taken care of in the very best of style. When we arrived that afternoon I saw three brand new nice antenna poles all cut and trimmed, laying outside especially for my use. They were cut a number of miles from Paro and carried by bearers to the station. I found out that a room in the radio station had been completely rebuilt especially for me; even a bed was made for me (they don't use beds here since over 99% of the people sleep on the floor). A new kitchen was built for my cook to use, and even some special food was on hand for my use.

Everyone pitched in and helped me erect my Hy-Gain 14 AVQ vertical, which was installed on the very top of a good straight sixty foot pole. Even digging a hole here in Bhutan is a very tough job; rocks are everywhere. After two trial holes, we were successful in getting a hole three feet deep where the largest rock was no larger than my head. Remember that these fellows were digging only with their large knives and their hands to remove the dirt and rocks. Finally the antenna was up, and I took out my compass to see what was between me and the US. I saw that due north, about three miles away, there was a big mountain, covered with snow, about 6,000 feet above our altitude (we were about 8,000 feet). To the south there was the Paro valley with the Paro river in its middle and rice paddies on each side. To the west was a mountain, and to the east was a mountain . . . it's mountains all around you, regardless of where you are in Bhutan, and they are always higher than you are!

I operated during the night, the band folded up about 0300, I ate breakfast, and into the Jeep and go. There are many things away to the Dzong I went to see the celebration, which lasted five days.

Inside the walls of the Dzong, people were sitting all around an open spot. There was not one other Westerner there but me. I had secured permission from the Head Lama that I could take all the pictures I wanted to. They had me a chair on hand to use, situated right in the middle of the crowd, at a nice spot to see all the events as they took place. There were about 10,000 people in the crowd the first day.

All of a sudden, I heard the most unusual horn blowing, and up on the roof were two Lamas blowing two big long Tibetan horns . . . about fifteen feet long. These fellows all during the events acted as "introducers" to each event as it started.

There were lots of dogs present, and to control them and also people who got too close, there were a few . . . let's call them "crowd controllers" . . . who were really on the job all during the five days. These fellows were really free with their whips, regardless of whether it was a dog or a person. Their whips would strike out and whoever was in its path knew to move back. I must say these fellows kept everything under control too! I was glad I was not on the front row!

All during the events, there were about four red-masked clowns on hand to liven up things, and I would like to tell you *everything* they did, but if I were really to describe *everything,* Wayne Green would be arrested and sued for publishing such things. At times one or two of these clowns dressed like women . . . and such carrying on you have never seen . . . at least not in a mixed crowd!

First there was the procession of the Lamas in all their red garments, the High Lamas in their gold garments, and all the high ranking civilians in their very fanciest dress. This marching around lasted about thirty minutes. Then those loooong Tibetan horns blew, they all marched back inside a side room, and then one by one out came the Lamas dressed like animals, with masks on, in vari-colored garments. These were very colorful, and the masks had a sort of terrifying effect on me. The crowd controllers were very busy with those mean looking whips, whacking dogs and people. During the week those masks got more frightening looking all the time and the tempo of things gradually picked up all the time. To me, it was very hard to believe that what I was witnessing was taking place in the twentieth century.

On the first day, I was invited by the Head Lama . . . a very fine old man . . . to come up

on the third floor or the Dzong and have tea with him and a few other of the very highest Dzong officials. At about 11 am the first day I went up there and was served that good old (and I mean *old*) yak butter tea! Now, if you want something to stick with you, it's yak butter tea. The flavor has a lingering stay with you for a *long* time after it's all gone. They insisted I stay up there with them every day, which, incidentally, is considered a Great Honor. I ended up having every one of my lunches up there and tea at both the morning and afternoon tea sessions too . . . and I finally got where I could handle yak butter tea. Luckily for me I am from South Carolina, one of the rice eating sections of the US, because rice is their basic food here. But, oh brother, how they like to cook everything loaded with red hot peppers, just about ten times as hot as I am used to. I could handle yak butter tea ok, but I never did get to the point where I could really eat those red hot dishes loaded with pepper. I would nibble on a little of this and a little of that, but I was careful not to ever get a real mouthful of anything.

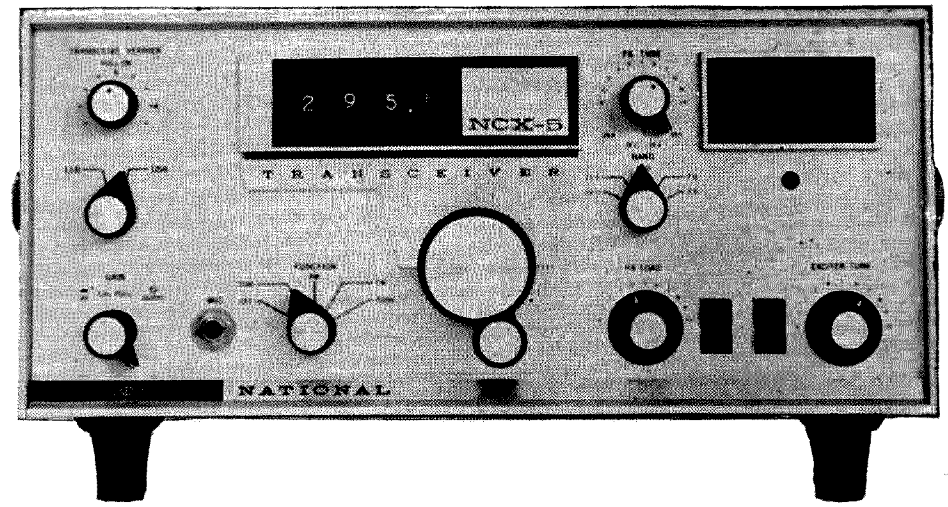
The next to the last day, they brought out the big Buddha . . . it took about twenty Lamas to carry it. This was carried all around the arena, turned round and round for all to see, and again all the Head Lamas and head civilians were in the procession. After the big Buddha was placed under its awning, all the Lamas and important civilians prostrated themselves in front of it three or four times. I only wish I understood Buddhism, because all this has lots of meaning; each event has an explanation as to what it's supposed to be representing.

The last day was the most exciting; things were at a high tempo near the end of the day. All of a sudden, everyone started whistling and sort of shouting and out from the Dzong ran about ten of the most frightening "demons" you have ever seen. These fellows had a half moon shaped instrument in their hands, made of iron about half an inch thick, with a very small rubber tip on its end. They beat the drums with this . . . I mean, they usually beat the drums with this, but not this time. These demons ran all through the crowd, jumping over people's heads. Everyone was shouting and whistling, and so were these demons. In one hand, they carried one of those very odd looking painted drums. They would hit the drum a few times and then they would hit the people on their heads with this instrument, and I don't mean "love taps" either. For a while they did not bother me, until one of the clowns pointed me out and then I got those taps on my bald head. A few of those taps caused me to rub my head. This kept up for about fifteen minutes. The natives who had babies with them held the little fellow's heads up high so that they would be tapped also; of course, these were gentle taps. I am sure everyone got at least ten whacks, then all the demons gathered out in the middle of the arena again and danced around for a while. Then the crowd started whistling and carrying on and . . . back to the crowd they all ran, all heads were whacked again any number of times, things died down, and back to the arena the demons went again. More dancing, the crowd started that whistling and yelling again, and back to the crowd the demons came and more head tapping took place. They did this three different times. I saw quite a number of people rubbing their heads but they must have loved those whacks because they kept asking for more and more. I got my share too! I asked one of the Dzong Lamas who could speak a little English just what this meant. He explained to me that the head tapping was supposed to run all the demons out of your system. There must have been lots of demons in the people, because it took about an hour of head beating to get rid of the demons in everyone!

There were all those dogs running around and very often there was a big dog fight. All the people bring their food with them, and since there is never any sort of an intermission during the entire day, they just eat when they want to. Now, when there are lots of people eating right on the ground and there are lots of loose dogs running around, some funny things happen. A dog will run up to someone's dinner and grab a mouthful of food and away the dog scrams with rocks being thrown at him and a lot of yelling. This was certainly some get-together. Just think, for five solid days from 8 am until 5 pm, one thing following another, no intermission at all, not one moment lost and never any repeats. Everything was taken in sort of a holiday mood and no one ever got mad! All considered, this was one of the most enjoyable weeks I have ever spent in any country . . . the nice part of it all, was none of this in any way QRMed my ham activity, since it started at 0230 GMT and ended at 1130 GMT.

You know, I gotta stop getting away from my story, but I think all these side lights are interesting, so I guess it's no harm to wander from the main theme once in a while.

That's it, fellows . . . I will get back on the ball in the next issue of 73 . . . this I promise you! . . . Gus



The National NCX-5

Bob Mitchell W5DWT
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Greenville, Texas

The NCX-5 and I became involved when a friend, W3BTQ/5, bought one for use on an extended field trip. Len lives in a no-antenna apartment and asked me to give the rig a thorough shakedown on my good antenna. So I brought the Five home. I was prepared to be prejudiced against the NCX-5 even though I've been a National fan since that day thirty years ago when I first turned the dial on the venerable—then new—HRO. Nevertheless, it seemed improbable that gentlemen from Massachusetts could put all they claimed in a little $685 box.

I decided first to check the stability and dial accuracy of the rig. On all bands but 15 meters, the calibration ran within a kilocycle. So I followed the vfo linearity adjustments described in the excellent instruction manual. To my amazement, the dial was then within 200 cycles from 3.5 to 4.0 mc. An adjustment of the heterodyne oscillator crystals put all bands on the same standard of accuracy.

Next I adjusted the vfo sideband switching as described in the manual. The Five gave zero beat on either side at 3.8 and was off only a couple of hundred cycles at the band edges. This is unavoidable with this type of sideband selection unless the designer further complicates the circuit.

Drift measurement was next. Initially the rig drifted about 600 cycles within 15 minutes after a cold start. then stabilized to less than 100 cycles drift. Three adjustments brought the total drift under *100* cycles at 3.8 mc with a little more—up to 200 cycles—at band edges. I was getting tired of waiting for the rig to cool for measurements and the drift was so small that it was becoming annoying to measure it, so I stopped my adjustments.

So I put the Five on the air barefoot. In one 34 minute period at nine on a poor night, I worked a KM6 on 15, a KH6, a W7 and a KA9 on 20, a WØ in North Dakota on 40, and a W5 in Houston on 80. All of the reports ran from S9 to 40-over. All commented on the excellent quality of the signal.

The NCX-5 also works on 10 and on cw. The keying is heavy and sounded very good. I was disappointed to find that I had to lif the lid for carrier balance to get a carrier fc cw, but the new NCX-5 Mark II has elim nated this problem with a front panel carri insertion control.

Up in the air over RTTY?

By this time, I decided to get scientific. First, I checked for output on all bands. It ran 110 watts or better. Interestingly, the little 6GJ5 output tubes (two in parallel) run very stably with over 200 watts input for five or ten minutes. Most rigs with 6146's in the output experience some drift in plate current under key-down conditions over similar periods. Output was unusually uniform from band-to-band. Incidentally, "side-band suppression" ran 35 db or more.

Next I checked the receiver selectivity. It ran just about as advertised: 2.8 kc at 6 db, with a shape factor of slightly under the advertised 1.7:1.

Sensitivity was excellent. On cw and ssb positions, a one-tenth microvolt signal was clearly audible on all bands. A one-half microvolt signal gave better than 10 db S + N/N ratio on all bands. The S-meter calibration was good, with less variation from and-to-band than most sets.

I had apprehensions about cross modulation and overload in view of the two rf stages in the Five's receiver section. The Five wasn't perfect on this score, but it was better than several medium-to-high priced receivers I had tested. I gave it extensive tests and found excellent front-end characteristics.

AGC on the Five is outstanding. I like it better than any other I have ever used on ssb or cw. For example, one morning I was working two mobiles on 3920. One was three miles away, and was pinning the meter. The other was over 50 miles away, and was running S-7 on peaks. The minimum difference in signal levels (by signal generator calibration) was 44 db. The rf gain was full on, and both signals were completely readable without resetting the rf gain control. What else can be said, other than that the AGC has no snap, crackle, pop, or thump?

The ALC also worked. It appeared to have the 10 db compression ratio claimed. I am not completely enamored of ALC, because too many operators use it as a substitute for brains. Once the ALC compression ratio is exceeded, all sorts of unfortunate things happen. The NCX-5 isn't any smarter here than any other transmitter. ALC can also be disadvantageous on cw and am. Fortunately, National cleverly disconnects the Five's ALC on cw.

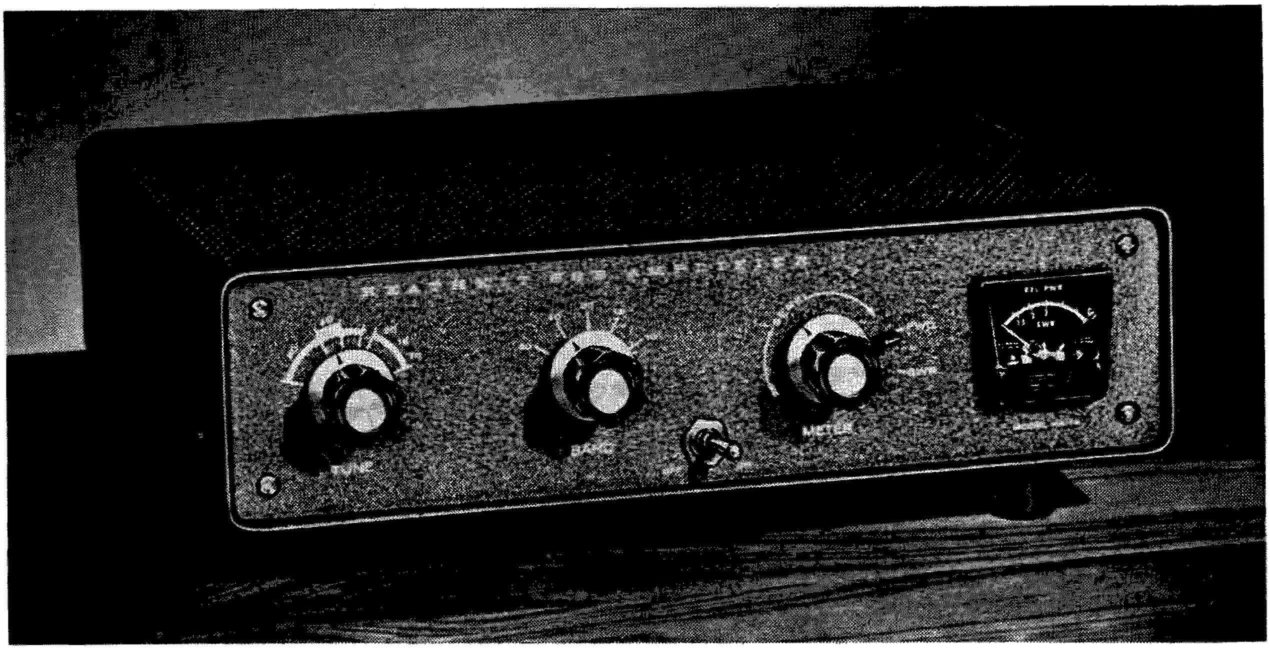
As for the VOX—it worked, too. I prefer a foot or hand switch, but that applies to all rigs, and the NCX-5 has a very satisfactory VOX.

And the dial—it is superb. I was prepared to dislike it because it looked like a counter dial, and my experience has been that they bind, thump, jump, slip. (They have backlash, too.) This one was just a dial that could be tuned easily and read better than most dials. The dial felt as it should. Tuning rate makes stations easy to tune. I put my 200-cycle audio band-pass filter behind the Five, and could tune in cw stations easily. The 3.5 mc and 28 mc ranges tune backwards. The dial very cleverly shifts gears and disguises this, but the crank still turns backwards. National is not unique in using "backward tuning" on some bands, but they have done a fine job of concealing it with the dial. In fact, some users haven't even noticed this until it has been pointed out!

One thing seems to be missing—a noise limiter. The NCX-5 isn't unique here either. If the Five had belonged to me it would have had a Bishop ifnl system, which, while not perfect, is better than no limiter at all. The Five might be able to use an internal keying monitor, too, for us old fashioned types who still use some cw. I use an external, rf activated system, and didn't miss the internal monitor. However, each of these items would add to the price tag.

So, all-in-all, I like the Five. It has an excellent receiver and transmitter. It generates no TVI in this fringe area on Channels 4, 5, 8, or 11. It works. It does what the book says. That dial is a dandy. The vfo is almost unbelievably good. The gentlemen from Melrose have done a fine job on this little box. I still don't know how they did it for the money.

. . . W5DWT



The Little Bomb

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"A 1000 watt, 5 band linear amplifier weighing 7 pounds?"

Well, it *is* possible, it has finally been done, it goes *mobile*, and best of all, it costs only $99.95.

It's the new Heathkit HA-14 "KW Kompact" linear amplifier. And "kompact" it is—12 inches wide, 10 inches deep, 3 inches thick, and weighing only 7 pounds!

Basically, Heath took their SB-200 (champion of the low cost kilowatts), removed the power supply, reduced the metering functions to two, and then shrunk the whole thing into a tiny cabinet.

The power supply comes extra. You can get either the HP-24 for 120/240 volt ac operation at $49.95, or (here you go mobile fans) the HP-14 for 12 volt, negative ground d.c. operation at $89.95. Both supply all voltages for a full, rounded 1000 watts PEP on sideband, and, since they are separate, they can be conveniently located remotely.

The HA-14 uses either a pair of T160L's or 572-B's in a parallel, grounded grid, class B configuration. It makes no difference which tube number you get, because both will perform equally well. Driving power needed for full rated output is 100 watts.

There is no blower. Ventilation of the two graphite anode power tubes is accomplished by natural convection currents flowing through the completely perforated steel cabinet. My experience so far has indicated that a blower is not necessary.

The KW Kompact features a built-in relative power/SWR meter. It measures relative power and SWR of the exciter plus the linear, or simply the exciter alone. The meter aids greatly in adjusting those sometimes balky mobile antennas. The built-in antenna changeover relay is in a neat little exciter controlled circuit that makes it easy to switch from higl

Continued on page 9

Improve Your

Here are a couple of modifications that will make your single band Swan an even better rig than it is now.

One problem that almost every Swan owner has run into is frequency modulation of the vfo when the supply voltage is low or the final isn't loaded heavily enough. When going mobile this problem can become quite severe. Another associated problem is that in mobile operation changes in supply voltage are large enough to cause a two to one change in resting current. Both of these problems may be seen to come from the final amplifier screen circuit.

In the case of the vfo stability, large amounts of screen current passing through R12 cause the VR tube to go out. If the final is loaded very heavily this problem can be kept to a minimum. The resting current problem is just due to the fluxation in screen voltage.

The solution to both these problems is to regulate the screen voltage of the final and not draw the screen current through R12. Shown in Fig. 1 is a circuit that will maintain a constant 220 volts on the screen of the final for supply voltages down to 250 volts. It also regulates some elements of V5 and V6 on receive at no extra charge.

Only one wiring change is necessary in the original circuit of the Swan. The lead from the junction of R12 and R13 to the 220 volt contact of relay K1 must be disconnected at one end. The tubes can easily be mounted under the chassis using a small bracket. A 6AW8 triode pentode can be used in this cir-

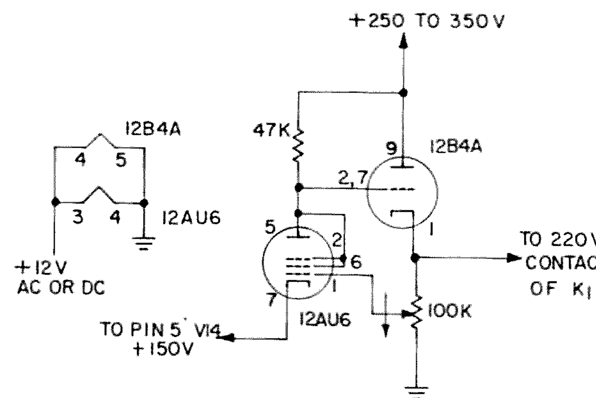

Fig. 1. Screen regulator supply.

Monoband Swan

cuit by connecting the pentode section as a triode and using it as the series regulator tube. The triode section will be the feedback amplifier. This change in tube will give good results except that the screen voltage will drop about 20 volts on voice peaks.

Another interesting modification that can be made is to arrange for class C operation. Some people are interested in mobile CW on their vacation and many people still have that plate modulator available for plate modulation of their mobile rig. The circuit for switchable changing to class C operation is shown in Fig. 2.

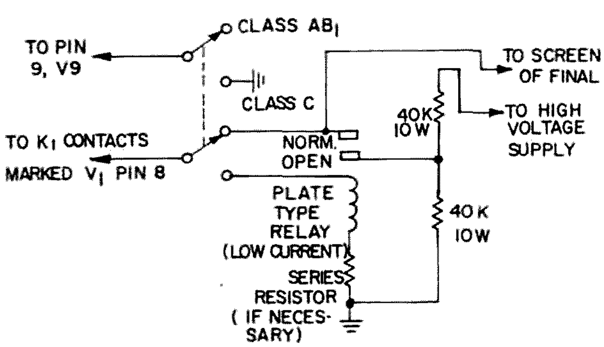

Fig. 2. Class C modification.

From Fig. 2 it can be seen that the lead from the screen of the final to the relay has been removed. It is also necessary to change the screen bypass capacitors from .01 to .001 for AM operation.

In the class C position the balanced modulator is unbalanced by the top half of the switch. The other half of the switch allows the relay to be energized during transmit time. The screen now gets its power through a 40K dropping resistor. This will cause the screen voltage to be about 130 volts. With this screen voltage and the same grid bias used in linear operation the 6DQ5 is being operated class C. There will be about 1 ma of grid current but little or no grid current is necessary to get good efficient class C operation with this tube. In class C operation the final may be loaded to 150 ma plate current which will give an output of at least three times that which may be obtained from inserting carrier in linear operation, staying within maximum dissipation ratings of the tube.

. . . K6LGW

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That Unwanted Sideband

If you've been following our sideband series this far, you may have noticed by now that (unlike most other references to the subject) we have *not* been specifying either single or double sideband!

And, like for most everything that happens in these pages, there's a reason—though it may seem a trifle strange.

The reason is this: so far as communication is concerned, it makes not the slightest bit of difference whether the signal sent through the ether has one or two sidebands. Since the normal two sidebands are mirror images of each other, only one is necessary. However, it's sometimes simpler at the transmitter end to send both of 'em along.

Unfortunately, present-day receiving techniques make it almost impossible to receive a double-sideband signal without extreme distortion. The reason is that the locally supplied carrier must be in exact phase with the (absent) original carrier for distortion-free demodulation—and this requirement for exact phase accuracy means precision impossible to attain by conventional techniques.

One technique exists for demodulating DSB signals the right way, making use of the phase information contained in the two sidebands themselves to correct the local carrier. This is the Webb synchronous-reception adapter, described originally in CQ some six years ago and in shorter form in Stoner's sideband handbook. However, since two audio phase-shift networks and something like eight tubes are required, the unit has never been very popular.

The more popular technique for receiving DSB signals is simply to get rid of one of the sidebands, thus making a SSB signal out of it—and these are relatively easy to demodulate.

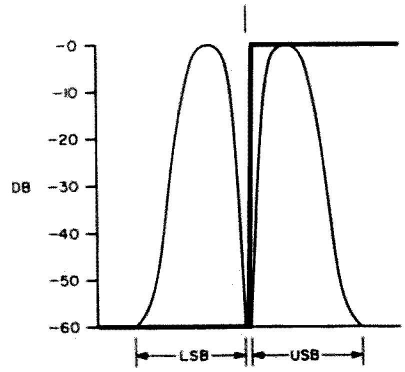


Fig. 1 Selectivity curve of ideal SSB filter

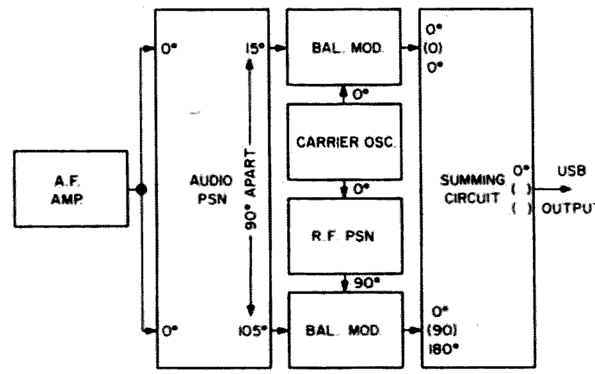


Fig. 2 Typical xmtr phasing unit

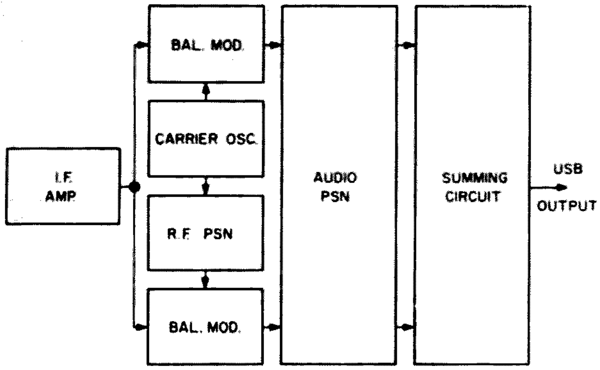


Fig. 3 Typical rcvr phasing unit

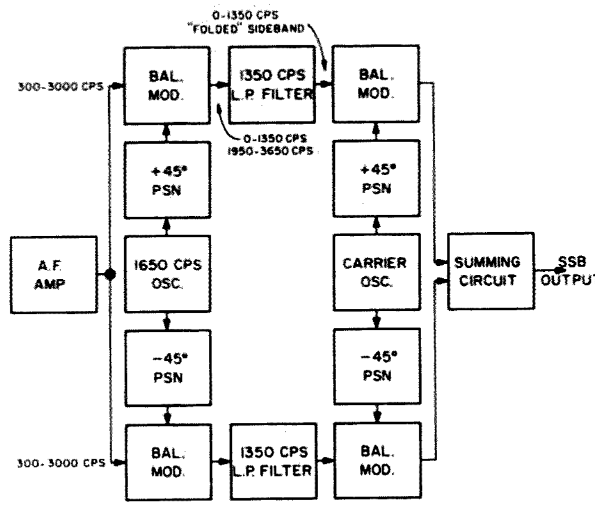


Fig. 4 Block diagram of third method

But—and this bears repeating—it makes no difference so far as communications are concerned whether this "unwanted" sideband is disposed of at the transmitter or at the receiver. If it is dumped out at the transmitter, twice as much talkpower may be transmitted for the same dc power input. On the other hand, if the orphan sideband is disposed of in the receiver, the receiving operator can take his choice as to which is the "orphan," which is sometimes a help in the case of QRM on just one of the sidebands.

The selectable-sideband feature, though, is more theoretical than practical, and will be so long as the present convention of using lower sideband on 75 and 40 and upper sideband on the higher bands is followed!

Anyhow, since the techniques for getting rid of the poor orphan little critter are the same whether employed in the transmitter or in the receiver, it only makes sense to examine them one time and one time only. Let's go:

Basically, we have our choice of three methods of getting rid of that unwanted sideband. These are the "filter" method, the "phasing" method, and (logically enough) the "third method." If we examine them in order, we'll find out just how logical that last name above really is!

The filter method is simplicity itself. We simply squeeze the DSB signal through a filter which is wide enough to let one sideband through but not wide enough for two. If the DSB signal is positioned properly in relation to the filter passband, one of the sidebands will be shaved off neatly while the other goes on through to be used.

But the simplicity of the filter method, in theory, is more than a bit deceiving when it comes to putting it in practice. The width of the DSB signal (assuming proper speech processing to limit audio bandwidth) will be in the neighborhood of 6 kc. The width of the

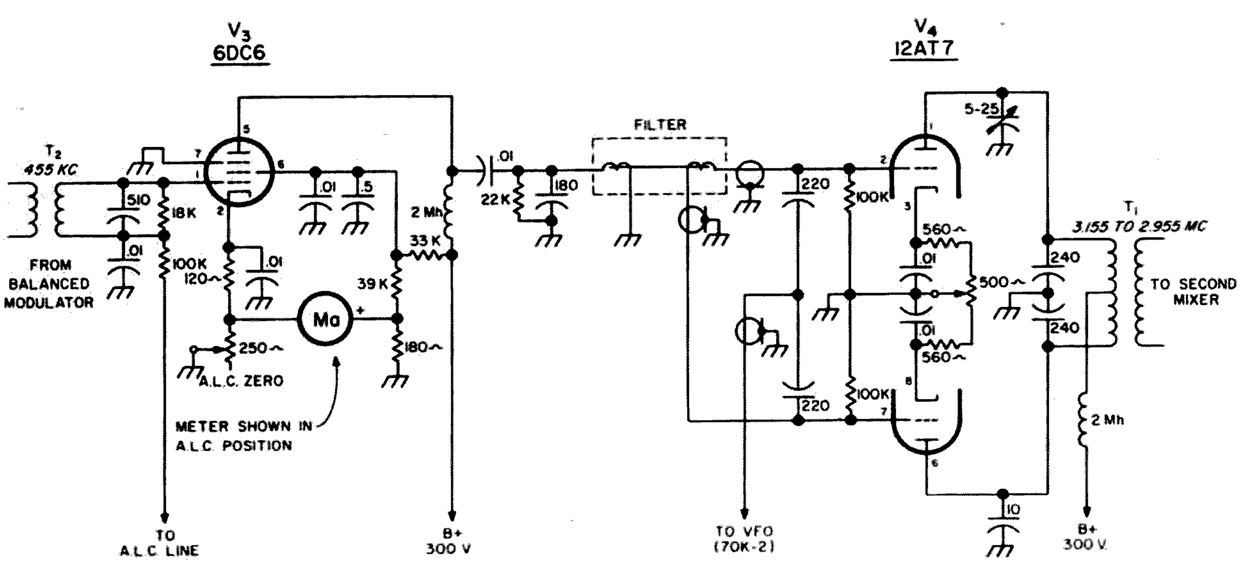


Fig. 5 Collins 32S1 filter circuit

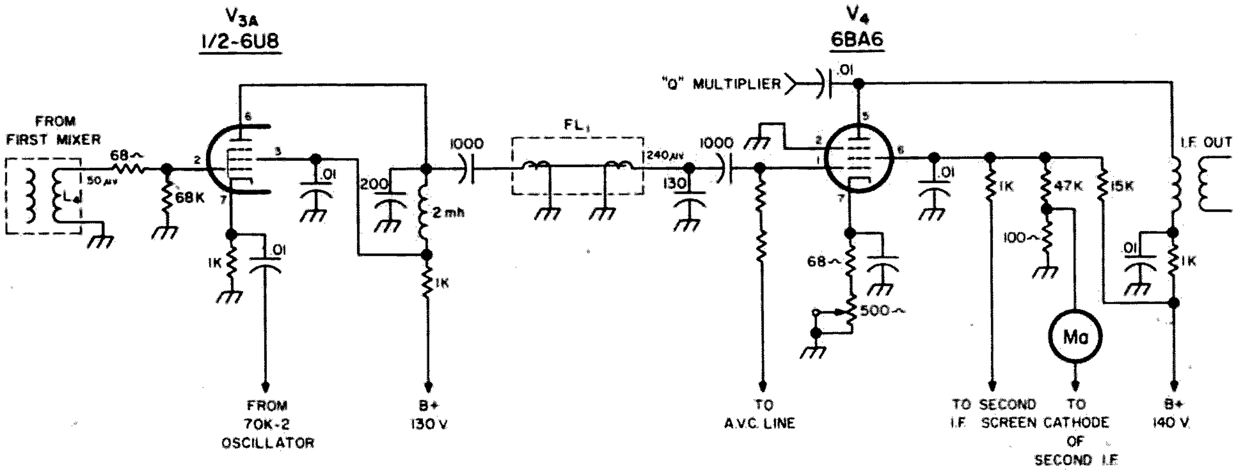


Fig. 6 Collins 75S1 filter circuit

filter passband, then, should not be over 3 kc. To get just-acceptable performance, the unwanted sideband should be attenuated at least 30 db—which means that we must have a filter which passes a 3-kc band with no attenuation, and at the same time rejects an immediately adjacent 3-kc band by 30 db!

The passband of such a filter would look something like Fig. 1—if we could get one. Unfortunately, we can't. We can get a reasonably (and usably) close approximation by using high-Q LC circuits at 17 to 20 kc, or by using crystal lattices at frequencies as high as 9 Mc. One of the more popular approaches to the filter situation is by use of a Collins mechanical filter at 455 kc. Obviously, the filter approach is going to require some frequency conversion to be useful, and so it appears to be a preferred approach for a receiver but not necessarily so good in a transmitter. However, other considerations enter into the picture and we find that many persons hold the belief that a filter approach outperforms the equally popular phasing method.

To sum up at this point, the filter approach is somewhat like a razor, shaving off the sides of the signal band so that just one sideband gets through. In theory it's simple, but in practice the extremely rapid rate of change required between passband and stopband makes the problem difficult. In spite of this,

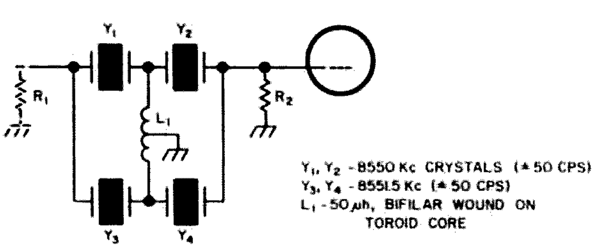


Fig. 7 Vester HF xtal filter

a number of highly successful filter designs are available.

How about the phasing method?

This approach is considerably more sophisticated in its concept, in that we make the unwanted sideband simply cancel itself out! To see how this can happen, take a look at Fig. 2.

This illustration shows how phasing can be employed in a transmitter. All phases mentioned, incidentally, are with reference to the phase of the "carrier oscillator"—without such a reference, the explanation can get too confusing to ever be comprehensible! It's bad enough, even with a reference!

First let's look at audio coming through the upper channel. The sidebands will have phase determined primarily by that of the carrier oscillator, so we can say that the entire output of balanced modulator I is in "zero-phase," or *in* phase with the reference.

However, the carrier supplied to balanced modulator II is shifted 90 degrees. In addition, the audio supplied to BMII is also shifted 90 degrees. These two 90-degree shifts of phase effectively cancel each other out so far as the *upper* sideband coming from BMII is concerned, leaving it at 0-degree phase. However, the phase shifts *add* for the lower sideband, making it 180 degrees out of phase.

If, now, we add the outputs of the two balanced modulators together (say, in a common tank circuit) the lower-sideband components will cancel each other out since they are 180 degrees out of phase. The upper-sideband components, on the other hand, being in-phase will reinforce each other. We don't worry about the carrier components, since they fail to survive the balanced modulators!

By changing the phase of the audio fed to either (but not both!) of the balanced modulators by 180 degrees, we can switch the ac

to low power in an instant. (and vice-versa)

Construction of the HA-14 couldn't have been simpler. All of the parts are top quality, made in U.S.A. types. Assembly time from parts to power was just 8 hours.

The instructions were great. Details are given on how to hook the linear up to nearly any exciter. The manual even gives modification procedures to provide an ALC input for the Heathkit Model HW-12, 22, and 32 singlebanders.

After you have finished soldering, there is one resistance check to make on the filament line. Then you're ready for the preliminary smoke test. This consists of several bias and filament voltage measurements. The high voltage is left disconnected, and no measurements are made on it.

The KW Kompact is very easy to operate. There are 5 controls in addition to the meter on the front panel—tune, band select, meter sensitivity, meter function, and on-off. With the linear turned off and switched to the band being used, you tune your exciter for 100 watts output. Then switch the linear "on" and rotate the "tune" control for maximum output as shown on the meter. Heath recommends that you work into an SWR of 2:1 or less. I have found that you start having difficulty in loading if you try to use an antenna with an SWR of 2:1 or over.

The HA-14 needed little adjustment when moving from the high to the low portion of the band.

With my little HW-32 and the KW Kompact, I acquired new "prestige" on the airwaves. I can now talk to VK's and ZL's with 5-8 signals with just a trap vertical.

With only four connections to make, it is easy to transfer the HA-14 from the shack to the car. It's hard to explain the feeling you get when you have 1000 watts in your mobile. That extra power sure helps cut through the QRM. And does it ever surprise a lot of hams when they see their S-meter peaking a-way up there—from a mobile! !

I used the Webster Top Sider antenna and their gallon coils with very good results. It's a good idea to keep people away from your mobile antenna while transmitting with the HA-14. Someone could get quite a surprise if they get hooked up with it as you call CQ-DX.

I put a sign on the back bumper reading "CAUTION—1000 watts." You'd be surprised how it kept people from following me too closely on the freeway!!

Heathkit's HA-14 KW Kompact is a real jewel—and, strictly state of the art.

. . . WB6KEH

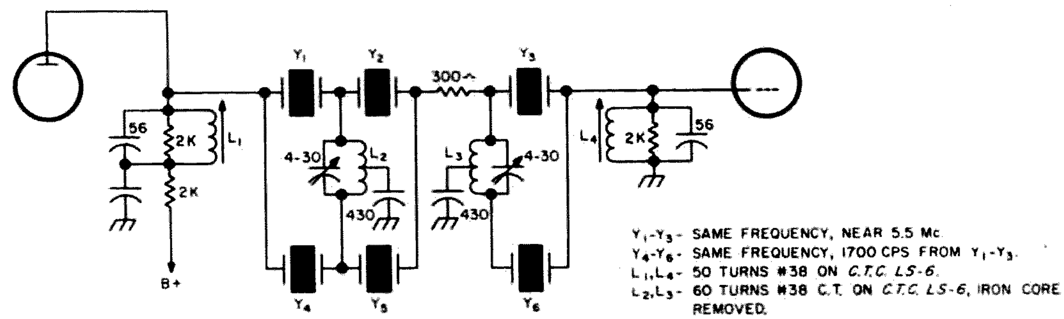


Fig. 8 Healey anti-spur HF xtal filter

tion so that the upper sideband cancels out and the lower gets through. This leads to a simple DPDT reversing switch, to select sideband!

How can this be applied to receivers? All we need do is to move things around a little as shown in Fig. 3. Now the phase-shift network for audio comes between the demodulators and the summing circuit, but that's the only major change. Operation is exactly the same; in effect, the signal is sliced in half precisely at the frequency of the carrier oscillator and everything on one side is rejected while everything on the other side passes through.

The major advantages of a phasing approach are the elimination of the requirement for rapid change of discrimination in a narrow frequency interval (which made filters so difficult in practice) and the ability to generate the SSB signal at any frequency desired rather than being limited by filter characteristics. Disadvantages are more critical adjustment requirements, and (in the past) expense of the audio phase-shift networks. However, present networks cost less than $5.

So what about the "third method"?

This is a technique which combines principles of both filters and phasing, but comes up with a result different from either. It was gone into in some detail in the September, 1957, issue of *QST*, but almost nothing has been mentioned about it since, although one commercial firm marketed a "third-method" unit for a time.

Basically, in this method, audio is limited to the 300-3000 cycle band and is applied to a pair of balanced modulators. (As shown in Fig. 4.) The first carrier is at 1650 cps, and is shifted +45 degrees for one bal-mod and −45 degrees for the other. Outputs of the two bal-mods go to sharp cutoff low-pass filters with 1350-cps cutoff frequencies. Thus the outputs of these filters consist of 0 to 1350 cps, DSB signals, in which corresponding sidebands are 90 degrees out of phase with each other.

Each of these signals is applied to another balanced modulator. Second carrier is at any convenient output frequency, and like the first carrier is shifted plus and minus 45 degrees.

The outputs of these bal-mods, then, consist of the sidebands of the second carrier, with phase relationships such that upper sidebands reinforce while lower sidebands cancel

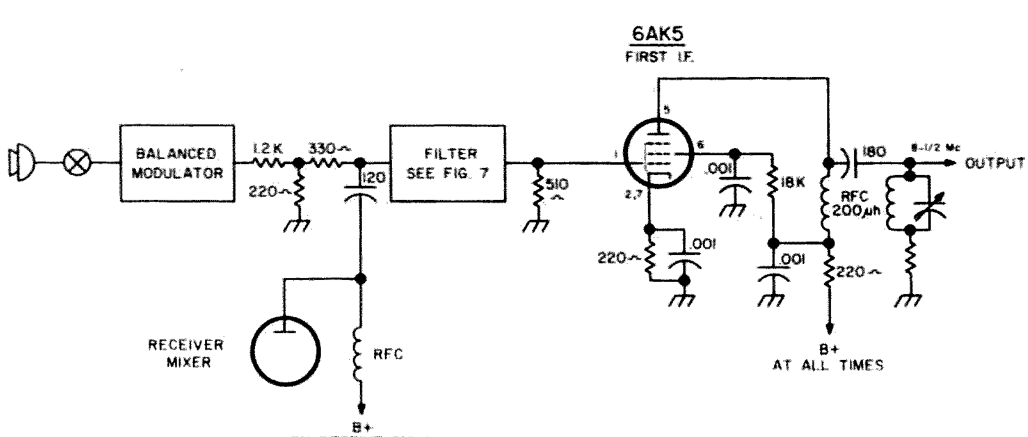


Fig. 9 Partial schematic of Vester transceiver

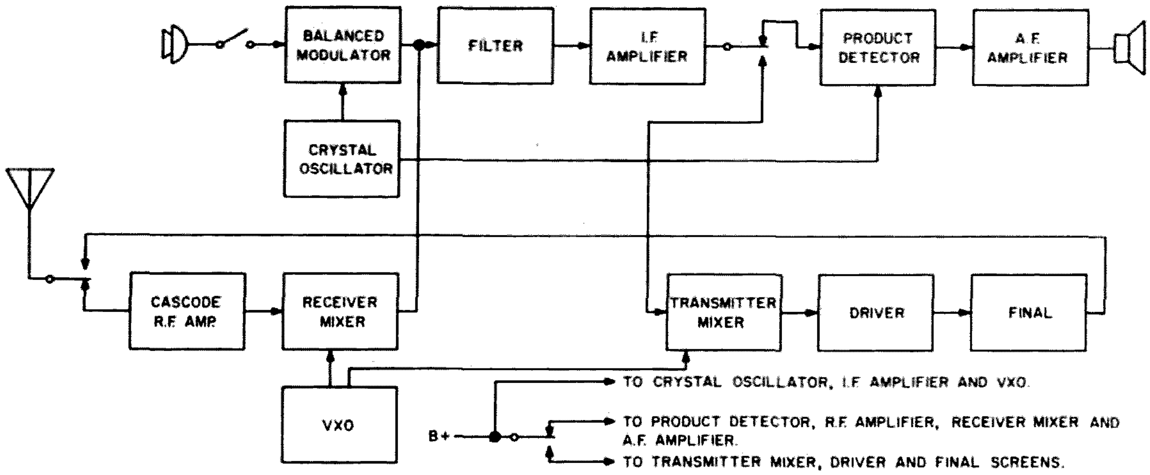


Fig. 10 Block diagram of Vester transceiver

out. In addition, half the spectrum is contributed by one channel while the other half comes from the other channel. And finally, any unwanted sideband appears inverted, right on top of the desired signal, instead of out to the side!

Let's take a closer look to add to the confusion—but if you really want to do anything with this system, go back to the original QST article by W1PNB!—and try to see how this inversion works.

The first carrier, being in the middle of the audio range, splits the signal rather rudely. It produces one "folded" sideband where you would expect a "lower" sideband, since the "difference" frequency between 3000 cps and 1650 cps is 1350 cps. The low-pass filters cutting off at 1350 cycles eliminate all the upper-sideband output of the first balanced modulators, leaving us with a pair of folded sidebands that reach from 1350 cps down to dc and back up to 1350. The "folding" around dc introduces a phase reversal of 180 degrees.

Now, when we modulate the second carrier with these folded sidebands, we find that we have in the output two perfectly good single-sideband signals *superimposed on each other.* The second carrier replaces the dc point as the "folding point," and the upper-lower sideband phase relationship combines with the 180-degree reversal introduced by the folding. From this point on, it's just like a straight phasing unit.

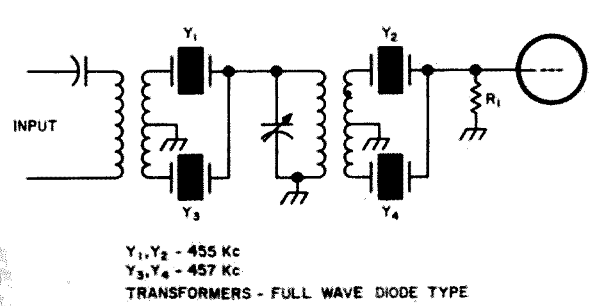


Fig. 11 455 kc xtal filter circuit

Apparent advantages of the third method are the complete elimination of any requirement for audio phase shifting, together with elimination of bandpass filters. Two spot-frequency phase shift networks are required, but these pose no problems. One sharp cutoff filter is needed, but this is easy enough at the frequency involved.

In addition, any drift of circuit adjustments will result only in degradation of the signal channel; it will *not* put unwanted spurious signals on other (even adjacent) channels.

Disadvantages include possibility of disturbing whine from the first carrier if any drift at all occurs, and quite a few more adjustments than either of the other systems. It is not certain whether this approach can be applied to a receiver as well as to a transmitter, either.

Some Detailed Examinations

At this point, we've taken general looks at the three ways of disposing of that unwanted sideband. Let's take a little more detailed view of the *practical* applications of these methods, to see what they entail. We might as well start with the general class of filters, to keep the same order as in our preliminary looks.

Most popular filter arrangement these days, it seems, revolves around Collins' little gem, the mechanical filter. Or, to give it its proper name, the magnetostrictive mechanical-resonance filter.

This filter (actually, there are many different models, but those most popular for ham use have similar characteristics) requires low-impedance feed, and has between 2 and 16 db

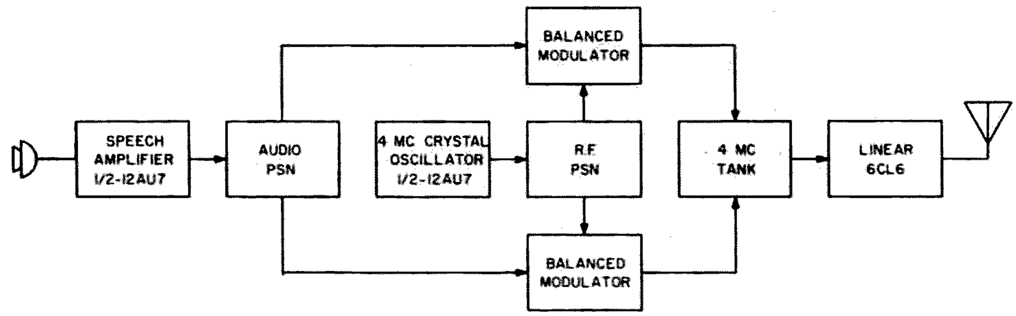


Fig. 12 Block diagram of GE SSB Jr.

of insertion loss in the passband according to Collins' handbook on SSB. Typical shape factor (ratio of bandwidth at 6 db down to that at 60 db down) is 2.2, the closest approach to the ideal 1.0 factor yet realized to date.

A typical circuit for use of this filter (taken from the Collins 32S-1) appears in Fig. 5. Note that in this case the filter is used between two *if* stages, rather than directly at the output of a balanced modulator.

A receiver circuit using the mechanical filter (from the 75S-1) is shown in Fig. 6. Filter-switching circuitry has been omitted from this schematic.

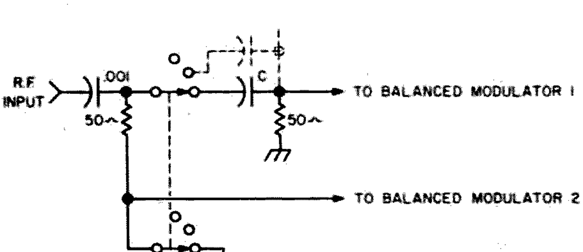
Though the mechanical filter is rightly popular, it has some disadvantages as well as advantages. Largest of the problems is the relatively low frequency at which it operates, making necessary several more frequency-conversion stages.

Recent developments in high-frequency crystal lattice filters have made it possible to apply the filter approach at frequencies as high as 9 Mc (the McCoy crystal filter is a typical commercial version), eliminating one set of conversion stages.

One of the pioneers of this approach was Benjamin H. Vester, W3TLN, whose article on "Surplus-Crystal High-Frequency Filters" in the January, 1959, QST stirred a storm of toroid-winding and experimentation. The extremely simple circuit he came up with is shown in Fig. 7. Resistance values R1 and R2 are critical; R1 is the apparent source impedance and should be as low as possible. Cathode-follower feed is ideal. R2 should be as high a resistance as will allow a smooth-topped passband; typical values are from 1000 to 4700 ohms. L1 is a bifilar-wound toroid, and you'll have to wind it yourself. Performance of this circuit was measured by Vester, who reported a shape factor of 2.0, with 6-db bandwidth of 2 kc and 60-db spread of 4 kc.

Some 18 months later, D. J. Healey, W3IIEC, pointed out a possible shortcoming of the Vester circuit. If the crystals have spurious responses, they may allow spurious signals through the filter. He offered an alternative circuit, shown in Fig. 8. Shape factor of this one (measured at 30 db down instead of 60, so not comparable to the other figures) is 1.44, while bandwidth is just under 3 kc. Complete details of this one appeared in the October, 1960, issue of QST, with updating in the January, 1961 issue.

One of the more interesting applications of these high-frequency filters has been in the construction of transceivers. One of the first described was Vester's, which appeared originally in the June, 1959, QST and has since



BAND (METERS)	C (pf)
75	817
40	439
20	223
15	150
10	110

Fig. 13 SB-10 rf psn circuit details

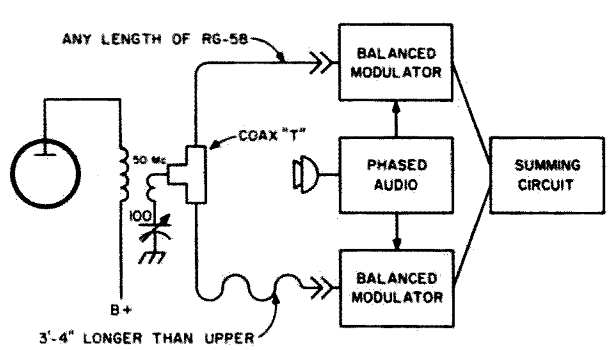


Fig. 14 Linear phasing unit arrangement

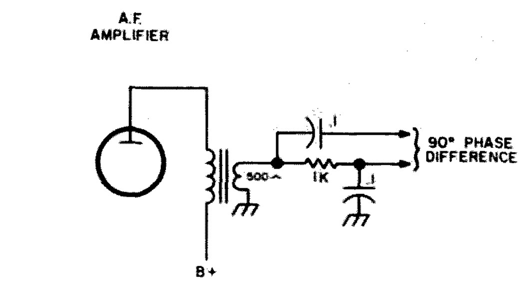


Fig. 15 Little Feller audio phasing network

been reprinted in recent editions of the ARRL Mobile Manual. The filter, *if* amplifier, balanced modulator output, and receiving mixer output circuits are shown in Fig. 9, while Fig. 10 is a simplified block diagram of the rig showing how the changeover from "transmit" to "receive" is accomplished by merely switching B+ from one set of tubes to another without disturbing signal-carrying connections except at one point.

Bridge and lattice crystal filters work as well at 455 kc as they do in the 9-Mc region, and existing sideband handbooks give ample information on the design and construction of such units. Like their higher-frequency brothers, these are medium-impedance devices, and passband shape may be most easily adjusted by varying the output load resistance. A typical circuit is shown in Fig. 11. This may be applied to either a transmitter or a receiver by substituting the proper circuit in the block marked "mixer."

Older texts on SSB devote considerable space to LC filter circuits operating at 50 kc and lower frequencies. These, for all practical purposes, are obsolete today. The sole exception is in the "third method" where sharp cutoff low-pass filters to eliminate everything above 1350 cps are required.

So, having looked more closely at filter circuits, let's turn our attention now to the phasing approach.

Though a phasing unit can operate at *any* rf frequency, it's been customary (since Wes Schum, W9DYV, chose to use it in his pioneering CE-10A exciter) to use a 9.0 Mc carrier. This can then be mixed with a 5-Mc vfo to get either 4-Mc LSB or 14-Mc USB, without switching.

But the first popular phasing exciter did *not* use 9 Mc. It was the "SSB, Jr." devised by Don Norgaard, W2KUJ, for G-E Ham News, and it operated at any chosen spot frequency in the 75-meter band.

This little 3-tube unit followed the same basic principles explained earlier; its block diagram appears in Fig. 12. Power output was some 2 watts. Any frequency change necessitated realignment of the rf phase-shift network.

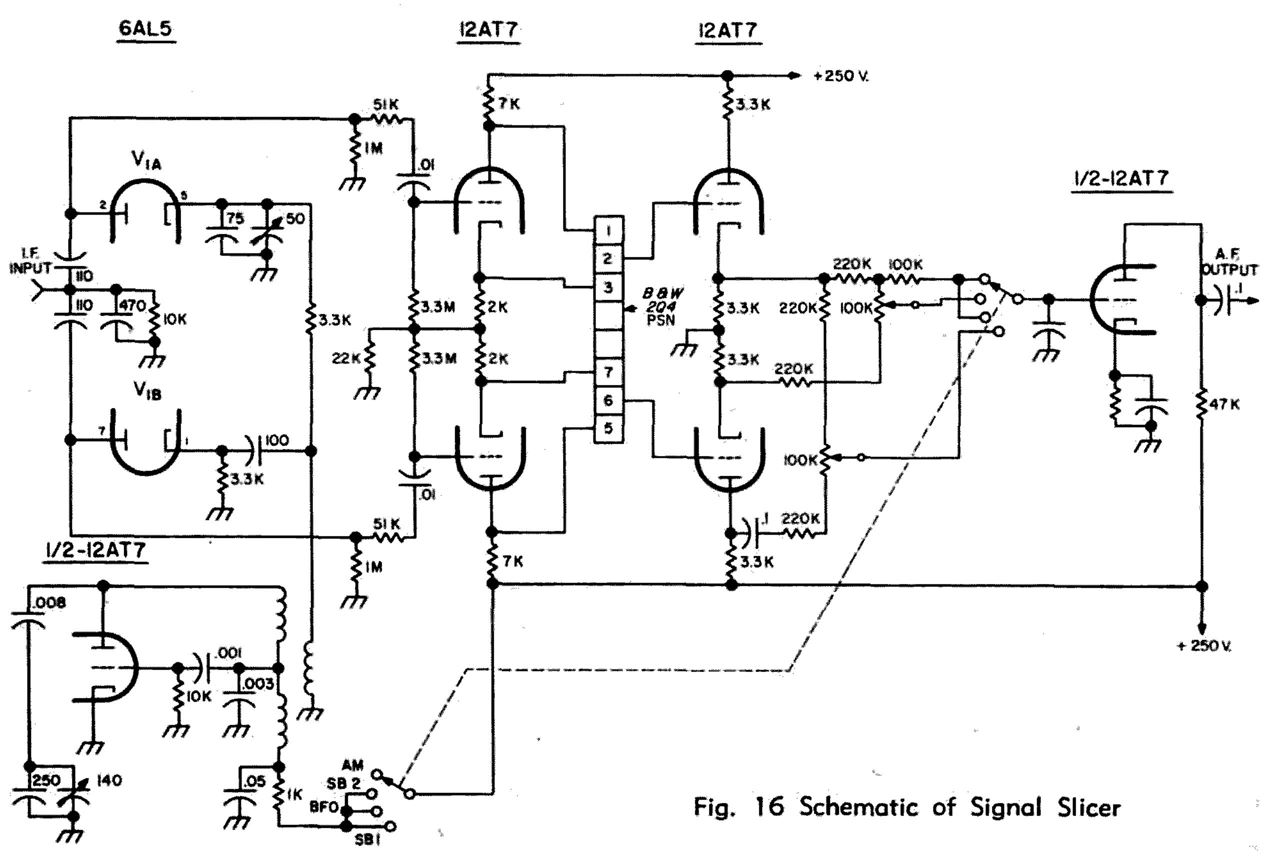


Fig. 16 Schematic of Signal Slicer

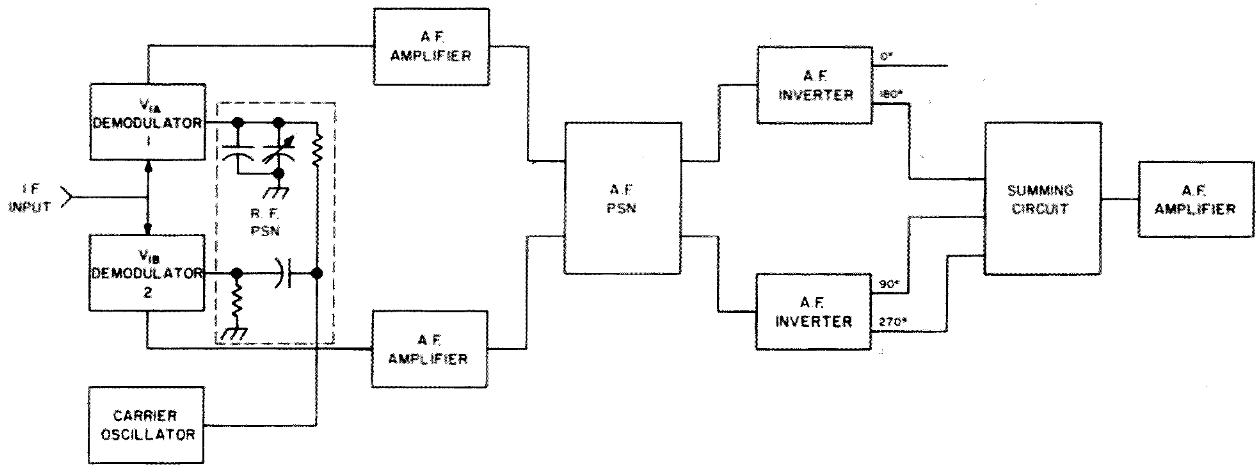


Fig. 17 Block diagram of circuit of Fig. 16 identifying component functions

The same basic circuit was adopted by W9DYV for the 10A exciter. He moved the operating frequency to 9 Mc and added a mixer, thus eliminating the need for realignment with every QSY. He also added a number of operating conveniences such as VOX—but those are apart from this discussion.

The next change of any significance in phasing exciters was introduction of Heath's SB-10 transmitter adapter, designed to accept the rf driver output of a standard AM transmitter and to convert it to SSB at operating frequency. The SSB signal is then returned to the original transmitter, where the final is readjusted to act as a linear amplifier.

The necessity for realignment of phase-shifting components with each frequency change is avoided by use of a broad-band passive rf phase-shift network, and switching a different such network into the circuit for every band covered. This part of the circuit, together with inputs to the balanced modulators, is shown in Fig. 13.

An interesting variant of the phasing type of exciter, especially suited for use at VHF, is the linear-phasing unit. This has not been fully described in print before, but most of the work on it has been done by a New York group. The rf phase shift is obtained by varying length of feedlines to the pairs of balanced modulators. For any frequency at which the two feedlines differ in length by 90 degrees, phase shift will be correct. As 90 degrees is ¼ wavelength, one line should be 12 inches longer than the other for operation on 144 Mc. At 50 Mc, the length difference would be 3 feet 4 inches. This line can be coiled up neatly and tucked out of the way.

A typical linear-phasing unit is shown schematically in Fig. 14. Although this unit is for 50-Mc use, it can be used equally well at frequencies up through 432 Mc by scaling line length appropriately.

A super-simplified phasing unit, especially for 50-Mc use, was described about a year ago by W5BCS and W5ORH who dubbed the entire unit "The Little Feller." Built around ZL1AAX's three-compartment audio phase shift network, together with a passive bridge rf network a la SB-10, the unit offered some 15 db suppression of the unwanted sideband provided a carbon mike with low response to higher frequencies was used. The phase shift network used in this rig appears in Fig. 15.

As we saw earlier, any phasing transmitting unit can be changed over to function as a receiving unit by simply moving the audio phase-shift network's location in the system. The original such unit was the General Electric YS-1 designed by Norgaard and described in QST in July, 1948. This unit was later simplified and described in G-E Ham News as the Signal Slicer, and in this version won immediate popularity. The schematic of the simplified unit appears in Fig. 16, while Fig. 17 shows a block diagram of the same unit to show which components perform what functions. This will allow you to substitute other building blocks, if you so desire, such as (for instance) the simplified audio phase-shift network of Fig. 15 instead of the specified commercial PSN.

Note that both the phasing and filter exciters described here provide only minute amounts of power. Most of them can perform nicely when connected directly to an antenna—but none of them will be rock-crushers used barefoot. How to get more power? Hook in a linear—and that's the subject of the next installment!

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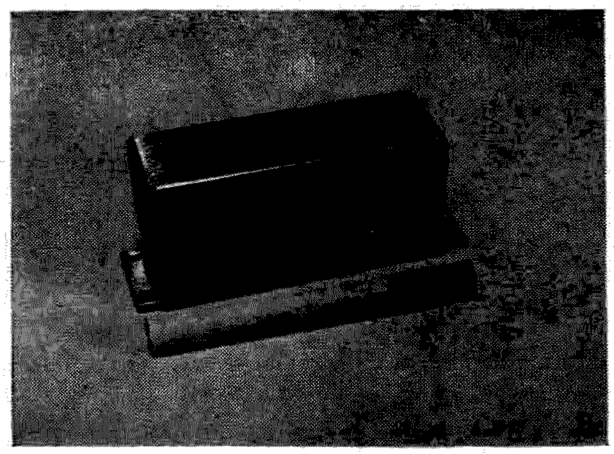

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DC Transformers

Since the very early days of radio there has been a demand for equipment to transform an available source of dc power to a different voltage level. In the past, rotating machinery was used almost exclusively for this purpose. The vibrator has taken first place for low power applications in more recent times. The vibrator by nature has a relatively low reliability, and the sparking contacts make it a first class noise generator. The amount of power which can be obtained from a low-voltage source is limited because of the need for large contacts to switch the high currents involved. The mass of the contacts limits the frequency to fairly low values and, hence, the power transformer which performs the actual voltage changing is comparable in size to 60 cycle power transformers. Efficiency is not high, especially at light loads, because a fair proportion of the input power is used just to move the vibrator contacts.

With the advent of semiconductor devices, it has become possible to build dc-to-dc converters which are simple, reliable and efficient.

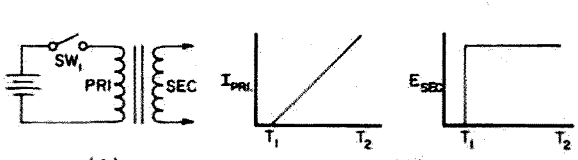


FIG. I

T_1 - SW_1 CLOSES
T_1 TO T_2 - SMALL COMPARED TO TIME CONSTANT

They can be made to operate at input voltages of from one to fifty or more volts and there is essentially no limit on the output voltage. Power outputs can range from milliwatts up to a kilowatt or more. Overall efficiency and overall physical size including output filters are comparable to 60 cycle power transformers alone. Hence, the title of this article, "DC Transformers."

Applications

Numerous articles have been written on dc-to-dc converters suitable for supplying power at voltages of several hundred volts for the plate supply to mobile vacuum tube receivers and transmitters. There is an equally important application in power supplies for portable and mobile transistorized equipment. Transistor rf output stages can now be built to give power outputs up to 50 watts or more. In order to achieve these power levels, collector supplies of 25 to 50 volts are needed. Converters operating from 12 volt batteries can be used in mobile installations for supplying collector voltages of this magnitude. In hand-held portable transceivers a battery supply of 3 to 6 volts can operate the receiver and modulator stages very nicely. However, voltages of 15 to 20 are desirable for the rf output stage especially at power levels of a watt or more. Since battery costs are roughly proportional to the number of cells, a 3 to 6 volt battery is considerably more economical than a 15 to 20 volt battery. A converter can be

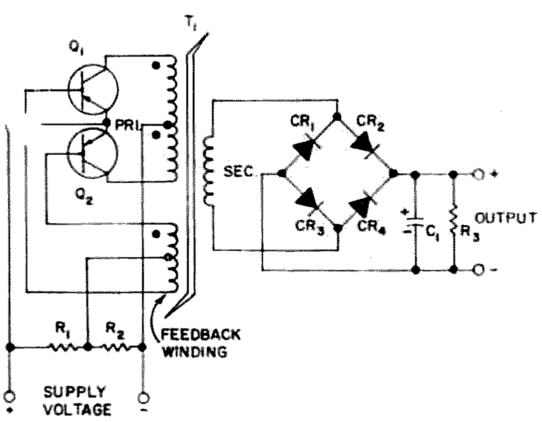


Fig. 2.

C_1—500 MFD 50 volt electrolytic

CR_1-CR_2-CR_3-CR_4—1N1219 Silicon rectifiers

Q_1-Q_2—Motorola 2N1544

R_1—3.3 Ω for 6 volt input, 6.8 Ω for 12 volt input. Both ½ watt

R_2—390 Ω for 6 volt input, 820 Ω for 12 volt input. Both ½ watt

R_3—3300 Ω for 25 volt output, 6800 Ω for 50 volt output. Both 1 watt

used to step up the battery voltage to 15 to 20 volts for the rf amplifier.

A third use for dc-to-dc converters is to provide opposite polarity voltages. Two voltage sources of opposite polarity are often desirable in transistor equipment but use of two separate batteries is inconvenient and uneconomical. Since the input and output of dc-to-dc converters can be completely isolated, they can be used to provide an opposite polarity source from a single battery.

Operating Principles

Before proceeding to a description of specific converter designs, it may be well to discuss some of the basic operating principles involved. Fig. 1(A) shows an iron core transformer, a battery and a switch. When the switch is closed, essentially the full battery voltage appears across the transformer primary. Because of the inductance of the primary, the current begins to increase at an essentially linear rate. This increase continues (not necessarily linearly) until the core either saturates or until the current is limited at some point below the saturation level by the coil resistance. During the time that the current is changing, a voltage is generated in the secondary. This voltage is constant during the time that the current is changing at a constant rate. Fig. 1(B) shows the current and voltage waveforms. If the battery polarity is reversed periodically at a rate such that steady state conditions are not reached between reversals, then a square wave of voltage is generated in the secondary. This polarity reversal is the function performed by the vibrator in a vibrator converter. In order to substitute transistors for the vibrator, the circuit of Fig. 2 is used. The primary is now divided into two sections by a center-tap and a third winding is added to provide drive voltage for the transistors. The symbol for the transformer core indicates that it is made of a material having a square hysteresis loop. In other words, it changes rapidly from the unsaturated to the saturated condition when the core flux reaches a specific level.

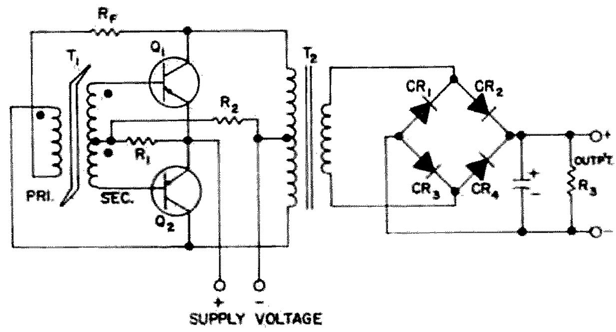


FIG. 3

C_1—100 MFD, 50 volt miniature electrolytic capacitor

CR_1-CR_2-CR_3-CR_4—1N645 miniature silicon diodes

Q_1-Q_2—RCA 2N1183 Transistors

R_1—22 Ω for 3 volt input, 47 Ω for 6 volt input, 270 Ω for 12 volt input. All ¼ w.

R_2—390 Ω for 6 volt input, 1800 Ω for 6 volt input, 6,800 Ω for 12 volt input. All ¼ w.

R_3—8200 Ω, ¼ watt

The transistors in this circuit operate as switches and here lies the explanation for the large power handling capability of even relatively small transistors. When the base is heavily forward biased, (base negative with

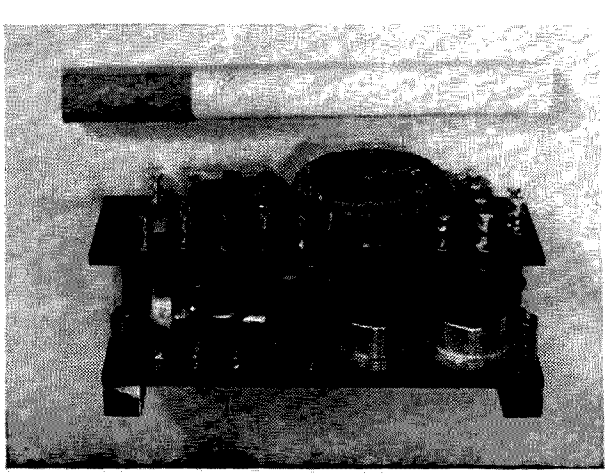


Fig. 4. Interior of dc transformer.

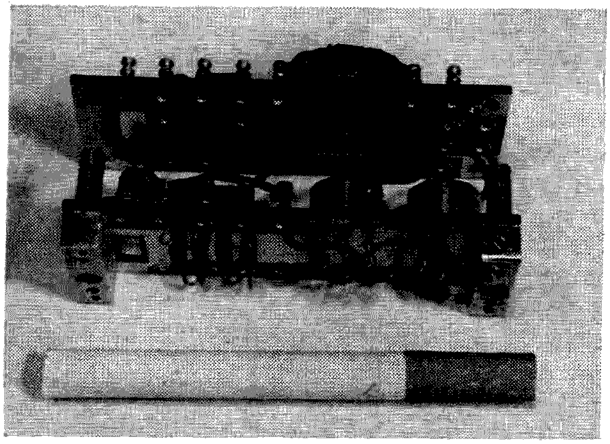


Fig. 5.

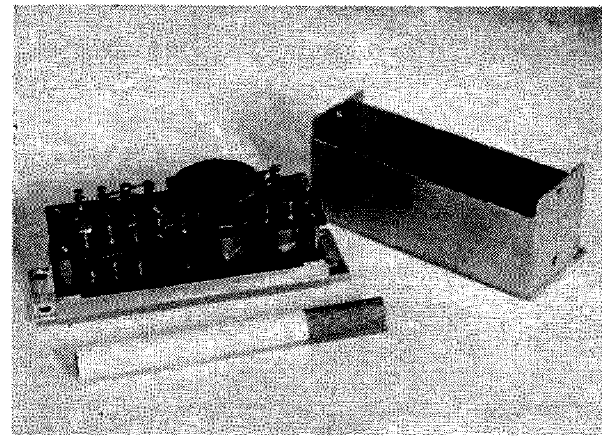


Fig. 6.

respect to emitter for PNP transistors) the transistor is switched on and the voltage between the emitter and collector is about 0.25 volts. In this condition, the collector dissipation is low ($0.25 \times I_c$) even though I_c (collector current) may be quite large. When the base is reverse biased, the transistor is switched off and the collector current is essentially zero. It is only during the transition period between on and off and vice versa that the dissipation is significant. If transistors are selected with frequency cutoff values ten or more times the maximum converter operating frequency, the transition time is small compared to the on and off times and the total dissipation is low. For this reason transistors used in converters can handle about ten times their normal Class A power rating. They must, however, have collector current ratings equal to or greater than the maximum input current. The current rating is the limiting condition for converters designed for very low input voltages.

The operation of the circuit of Fig. 2 is quite easy to visualize. When power is applied, resistor R_2 supplies a small initial forward bias to the bases of Q_1 and Q_2. This causes them to draw collector current through the primary windings of T_1. Small differences in Q_1 and Q_2 cause one or the other (let us assume Q_1) to draw slightly more current. The phasing of the feedback winding is such that current flow in the Q_1 half of the primary biases Q_1 on and Q_2 off. Q_1 is thus turned rapidly full on and Q_2 is turned full off. The current in the Q_1 half of the primary then increases until the transformer saturates. When the core saturates, the coupling between the windings is essentially zero and the bias on the bases from the feedback winding is removed. This turns Q_1 off and the flux in the transformer core begins to decay. This decaying flux generates a voltage in the feedback winding of opposite polarity and Q_2 is thus turned on and Q_1 held off. The current through the Q_2 half of the primary then increases until the core is saturated in the opposite direction and the oscillatory action proceeds at a rate determined largely by the applied voltage and the primary inductance. The voltage across the total primary is twice the supply voltage minus twice the voltage drop between transistor collector and emitter in the on condition. In other words, about one-half volt less than twice the input voltage. Q_1 and Q_2 must have a voltage rating (collector to emitter) of twice the supply voltage plus a safety factor of about 25% to protect against the voltage spikes generated by core saturation. The feedback winding is arranged to supply a somewhat larger voltage than required and resistor R_1 is selected to drop this voltage to a value just sufficient to turn Q_1 and Q_2 fully on under maximum load.

The secondary voltage is a square wave equal to twice the supply voltage (minus about 0.5 volt) times the turns ratio (secondary to total primary). Silicon diodes CR_1 through CR_4 rectify this square wave and C_1 filters out the small switching transients. The frequency is usually selected to be in the vicinity of one kilocycle and C_1 need not be very large in order to provide sufficient filtering at this frequency. C_1 serves an additional purpose, however, in that it prevents stopping of the oscillator by momentary overloads. R_3 is selected to draw a very small current (one to a few milliamperes) which is all that is needed to prevent C_1 from charging up to the peak of the spikes present on the secondary voltage. The regulation is very good up to the maximum load because of the square wave input to the rectifier. The output dc voltage is equal to the secondary voltage minus the rectifier drop of one to two volts. The

converter is not harmed by shorting the output. When the output is shorted, the feedback voltage drops and the converter stops oscillating. The input current drops to a low value under this condition.

The circuit of Fig. 2 is suitable for output powers up to 50 to 100 watts. Above this power level the circuit of Fig. 3 is more economical because only T_1 need have a core made of the more expensive square hysteresis loop material. T_2 is designed like a conventional power transformer in that the core does not saturate under any operating condition. The primary of T_1 and resistor R_f are proportioned so that the core of T_1 saturates and oscillation takes place in a manner similar to that described for the circuit of Fig. 2.

Typical DC-to-DC Converters

Figs. 4, 5, and 6 are photographs of a converter designed to supply 100 milliamperes at 20 volts or 200 milliamperes at ten volts from either a 3 volt or a 6 volt battery supply. It will also operate from a 12 volt supply and under this condition the output is 20 volts at 250 milliamperes or 40 volts at 125 milliamperes. The circuit is as shown in Fig. 2 except that the transformer has multiple primary and secondary windings in order to provide for the different input and output voltages. Fig. 7 is a schematic of the transformer construction and also gives component values for the circuit of Fig. 2. Full load efficiency ranges between 75% and 85% depending on which taps are in use. Frequency is nominally 1500 cycles at three or six volts input and 3000 cycles at 12 volts input. Exclusive of the mounting flanges on the baseplate, the converter occupies a volume of 3.9 cubic inches. The modular construction matches other units of a one watt output ten meter transceiver.

Fig. 8 is a photograph of a transformer designed to put out 40 watts at 12, 25 or 50 volts from either a 6 or 12 volt input supply. Fig. 9 is a schematic drawing of this transformer giving component information for the circuit

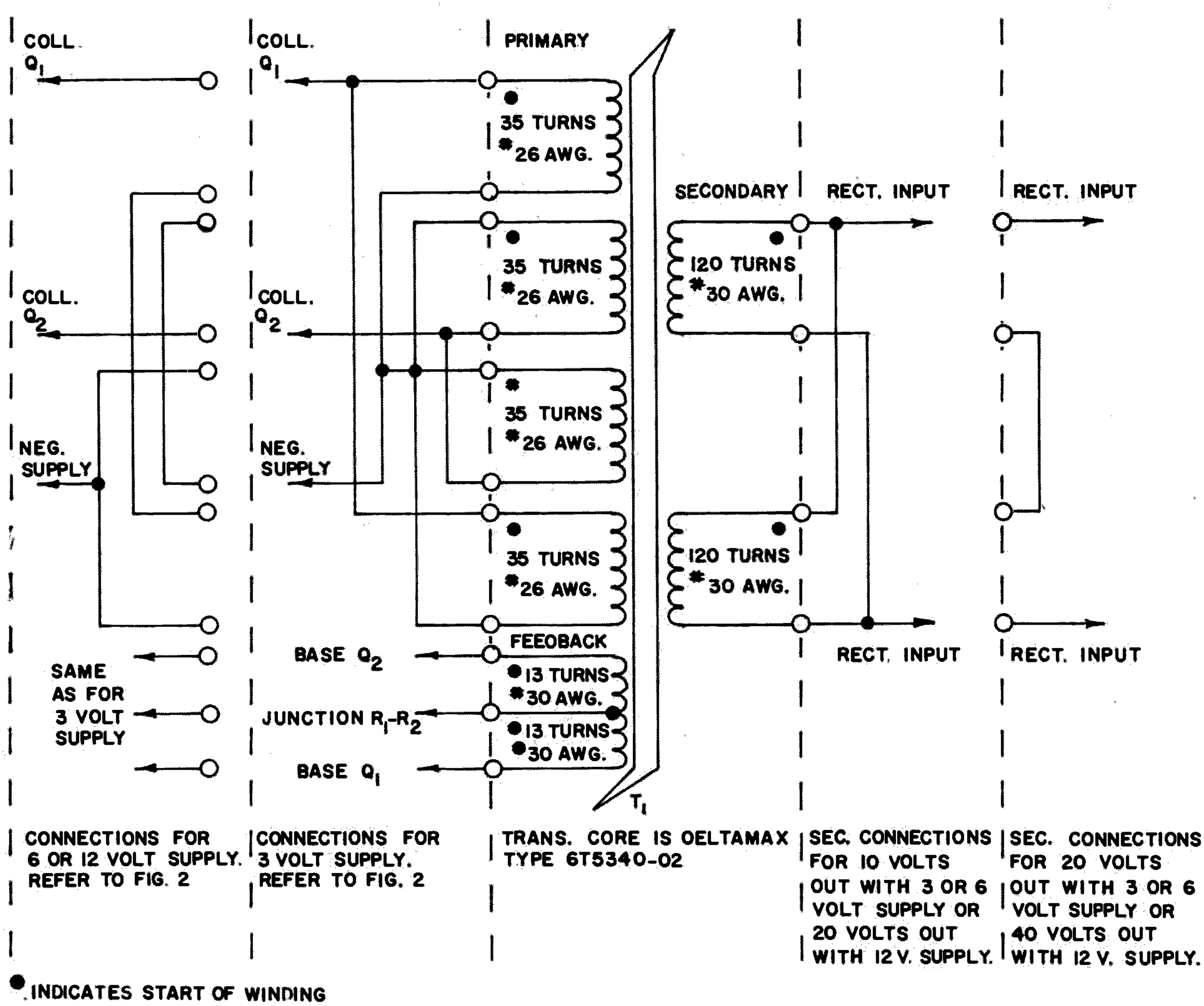


Fig. 7. Construction and connections for transformer used in dc to dc converter shown in photographs (Fig. 4, 5 & 6). Component values and connections refer to the circuit shown in Fig. 2.

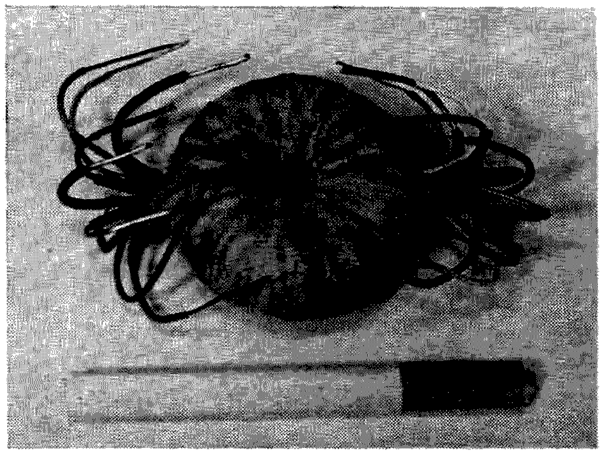


Fig. 8. Typical transformer.

of Fig. 2. The finished power supply including a 500 mfd, 50 volt output filter occupies a volume of 25 cubic inches. This unit is suitable as a power supply for a forty watt input mobile final amplifier using 2N1907 transistors.

Transformer Design

The most important component in these converters is the saturating core transformer (T_1). The core material is a grain-oriented alloy of nickel and iron. Grain-orientation is achieved by heavy cold rolling of the material into thin strip. The usual strip thickness for frequencies up to 2000 cycles is 2 mils. One mil material has lower losses at high frequencies and is used at frequencies above 2000 cycles. These thin materials are only practical when wound in continuous strip toroidal cores although six mil thick material can be obtained in the form of U shaped laminations. The material is strain sensitive and the finished cores are encased in aluminum, plastic, or epoxy coated aluminum cases to protect them from the strain from the windings. Complete, cased toroidal cores are available from a number of manufacturers. Two of the better known trade names for the material are Deltamax and Orthonol.[1]

Toroidal transformers are not difficult to wind by hand since relatively few turns are required. In order to understand the simple calculations involved, it is desirable to become familiar with some of the magnetic core terminology:

B—Magnetic induction or flux density per unit area measured perpendicular to the direction of the flux. In the CGS system of units, the unit of area is the square centimeter and the unit of magnetic induction is the gauss.

B_s—Magnetic induction per unit area at the core saturation level. This is the induction level at which a further increase in magnetizing force (current through the coil) does not produce a corresponding increase in induction.

ϕ—The magnetic flux existing in a given medium. The unit of measurement in the CGS system of units is the maxwell. Numerically equal to 2B or $2B_s$ times the effective cross-sectional area (A_{cnet}) of the core in square centimeters. The factor of 2 is present because ϕ is measured from the peak induction in one direction through zero to the peak induction in the other direction whereas B and B_s are measured from zero in one direction only.

A_c—Gross cross-sectional core area. For use with B_s and ϕ (CGS system), A_c should be measured in square centimeters.

A_{cnet}—A_c multiplied by a stacking factor which allows for the space between laminations (or turns of tape in toroidal cores). For 2 mil thick tape-wound cores, the stacking factor is usually 0.8. For one mil tape, it is 0.7.

Window Area—The area of the center opening in toroidal cores. Usually given in circular mils since this facilitates calculation of wire capacity. Area in circular mils is equal to 1.27×10^6 times the window area in square inches.

Winding Factor—The factor by which the window area must be multiplied in order to determine wire capacity. It allows for insulation between windings, space between wire turns, and the necessary residual hole left after the winding is completed. It is numerically equal to the total wire cross sectional-area including insulation divided by the window area with both areas given in circular mils. For machine-wound toroidal transformers, the winding factor varies between 0.2 and 0.4. The smaller number applies to the smaller cores and larger wire sizes. It is possible to achieve winding factors above 0.5 with hand winding and use of progressively smaller shuttles to carry the wire through the core window.

As a starting point for the transformer design, the desired wattage output and the nominal input and output voltages should be selected. Assume 80% efficiency and the input wattage is then:

[1] Deltamax cores are manufactured by the Arnold Engineering Company, Marengo, Illinois. Orthonol cores are manufactured by Magnetics, Inc., Butler, Pennsylvania.

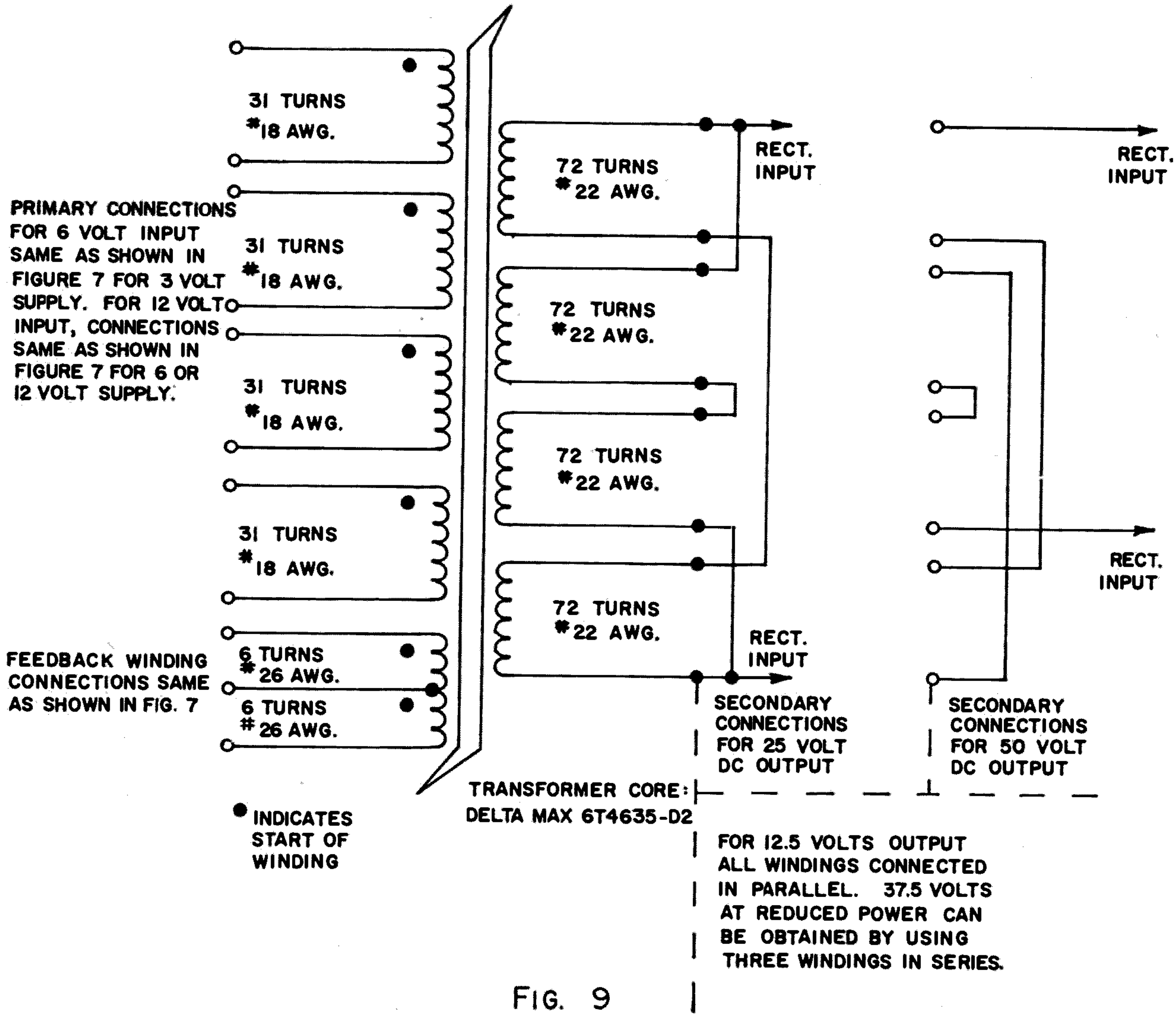


Fig. 9. Construction and connections for 40 watt converter transformer shown in Fig. 8. Component values and connections refer to the circuit of Fig. 2.

$$\text{Input watts} = \frac{\text{Output watts}}{0.8}$$

The input current is then found from:

$$I_{in} = \frac{\text{Input watts}}{E_{in}}$$

E_{in} is the lowest supply voltage expected minus 0.25 volts to allow for the voltage drop in the on transistor.

The primary wire size is then selected based on 500 circular mils per ampere. 500 circular mils is used instead of the usual 1000 because the primary halves draw current on alternate half-cycles. The secondary wire size is selected based on 1000 circular mils per ampere after the output current has been determined from the relationship:

$$I_{out} = \frac{\text{Output Watts}}{E_{out}}$$

A standard core size is then selected from the manufacturer's catalog. The net core area (A_{cnet}) in square centimeters is determined from the catalog and ϕ is calculated from:

$$\phi = 2\, B_s\, A_{c\,net}$$

($B_s = 14{,}500$ gausses for the core materials mentioned above)

The number of primary turns is then calculated from:

$$\text{Turns } (\tfrac{1}{2}\text{ pri}) = \frac{E_{in}}{2\,\phi\, f \times 10^{-8}}$$

(In this equation, f should not be more than one-tenth of the transistor cutoff frequency or more than 2000 cycles for 2 mil thick core material. 1200 cycles is a good nominal value)

The transformer turns-per-volt is then calculated from:

$$\text{Turns-per-volt} = \frac{E_{in}}{\text{Turns } (\tfrac{1}{2}\text{ pri})}$$

The secondary voltage should be about two volts greater than the desired dc output voltage to allow for rectifier drop. An additional increase of 3% to 5% in secondary voltage will compensate for resistance drop in the windings if it is essential that the nominal dc output voltage be available at the minimum input voltage (E_{in}). Because the secondary waveform is a square wave, it is unnecessary to allow for the usual drop caused by rectifying a sine wave. Secondary turns are determined from:

$$\text{Turns (sec)} = E_{sec} \times \text{Turns-per-volt}$$

The number of turns in the feedback winding is determined in the same way. Each half of the feedback winding should have an output voltage of from 1.5 to 2.0 volts for germanium transistors or 2.5 to 3.0 volts for silicon transistors. The wire size can be as small as convenient providing that the area in circular mils is at least one-tenth that of the primary wire.

Next, it is necessary to determine whether all these turns of wire can be fitted into the window of the core that was selected. For this purpose it is necessary to know the cross-sectional area (including insulation) of each size of wire to be used. This can be determined from a wire table or calculated from the overall wire diameter. The total wire area is then:

Total wire area = (Turns, pri. × Wire area, pri) + (Turns, sec. x Wire area, sec)
(The feedback winding occupies so little space that it can be neglected in this calculation)

The total wire area in circular mils as determined above should then be divided by the core window area in circular mils. The result is the winding factor. If it is between 0.3 and 0.4 the windings should go on with ease. It is possible to make it if the winding factor is as high as 0.55 but don't count on it. If the winding factor is too large, select another core with a larger window or a larger cross-sectional area or both and perform the above calculations again. Similarly, if the winding factor is below 0.2, a smaller core should be selected. Winding factors this small mean that an unnecessarily large and expensive core has been selected. Also, the efficiency is lowered if too much space is wasted.

Transformer Construction

The two halves of the primary winding should be tightly coupled. This can be achieved either by bifilar winding or by multiple layer winding with the layers connected in an interleaved arrangement. The larger wire sizes (No. 14 and above) are difficult to wind on small cores. Two or more windings in parallel of equivalent circular mil area can be used to get around this difficulty. This procedure of parallel windings can also be used to achieve tight coupling and the capability of accepting different input voltages. The transformers shown in Figs. 7 and 9 are examples of the procedure. The primaries in these transformers consist of four sections with the same number of turns in each section. Each section occupies half of the core circumference and this, of course, results in two layers. When connected for the lower input voltage, the primary section occupying the first layer of one half-circumference is connected in parallel with the section occupying the second layer of the opposite half-circumference. For the higher input voltage, the same arrangement is used except that the sections are connected in series.

The feedback winding should be arranged so that it has uniform coupling to the total primary. This can be achieved by spacing the turns so that the winding occupies the entire core circumference. The secondary can be wound either in sections to provide multiple output voltages or as one continuous winding. The order in which the windings are placed on the core is not critical, but it is generally easier to wind the larger wire sizes first. Since the transformers usually step-up the voltage, this means that the primary should be wound first.

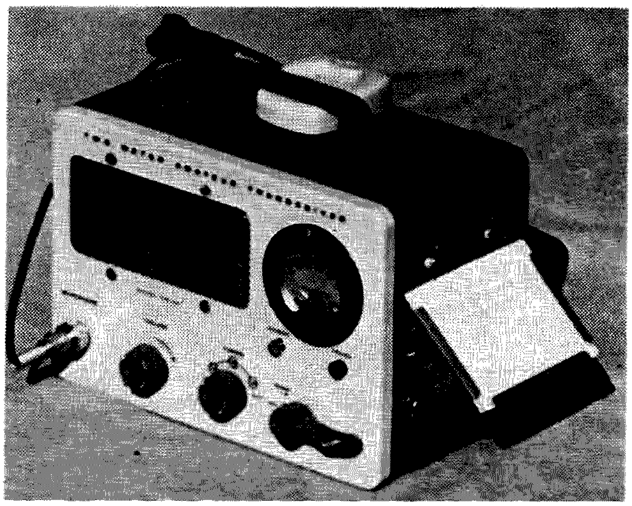
Windings with very few turns can be put on simply by cutting the required length of wire and threading the free end of the wire through the window for each turn. Longer lengths of wire are not too manageable when handled in this way and it is better to make a shuttle out of a strip of thin wood or plastic by filing notches in the ends of the strip. The required length of wire is then wound on the shuttle and the shuttle threaded through the window for each turn. The length of wire required can be determined by making a rough measurement of the average length of each turn with a piece of scrap wire and multiplying this by the number of turns.

Even with machine winding, toroidal transformer coils inevitably become scramble wound after the first layer, so heavy formvar or nylon insulated wire should be used to prevent shorts. Insulation between windings is not essential but it does facilitate keeping track of the number of turns. Acetate tape is best for insulation providing that very thin tape is used.

. . . W6ANU/

John W. Myrna WA2QZH
222 Franklin Avenue
Wyckoff, N. J., 07481

Getting the Most from Your Two'er



Back in April of 1961, when my Novice License was but two months old and a newly earned 15 wpm C.P. Certificate graced my wall, the fone bug bit me. Upon the recommendation of WA2SAB, who worked nine states with one, I bought a Heathkit Two'er.

One of the first problems that came up after the rig was put together, other than some debugging that I'll mention later, was the inaccessibility of the crystal socket. Taking off the case every time I wanted to change frequency just took too much time so down I went to my workshop for a hacksaw and drill. I hate to disfigure equipment so I decided to do a neat job. The license holder on the side of the Two'er is held on by three or four rivets and if a screwdriver is wedged between the license holder and the main case a little leverage will "pop" the holder off.

After removing the license holder, flatten it to its former shape if it is bent in the operation, and set it aside. With a hacksaw or saber saw cut the unpainted area exposed by the removal of the license holder. Be sure to leave a ¾ inch border on the bottom so the hole you cut remains above the chassis.

Now trot down to the hardware store and buy four inches of piano hinge. Attach ½ the hinge to the top of the license holder, after drilling suitable holes, and attach the other half of the hinge to the case through the lowest set of air holes above the hole cut in the side of the case. I typed up a little plate giving my name, address, call, etc. and put it in the license holder thus identifying who owns the rig and at the same time covering up the rivet holes. With the trap door I can now change crystals, final tubes, and adjust the transmitter stages. It's also a handy place to tape a couple of spare fuses.

The only transmitter control that needs frequent adjustment is the plate tuning capacitor (C16) which is just below the chassis. Drill a hole in the case over the capacitor and install a rubber grommet in the hole. In this way you can adjust the transmitter tuning with a small screwdriver. CAUTION: There are 150-200 volts on that capacitor so don't touch the metal part of the screwdriver and ground or you'll get a nice little shock. The grommet will prevent the screwdriver from shorting against the case. You'll find that the "trap door" will cover the grommet hole and the crystal hole making a neat job.

When tuning up the transmitter an output meter is essential. A meter mounted on the front panel is more convenient than one plugged in the back, especially when mobiling. Any meter with a sensitive movement will do, but if O- 1ma movement is used, the S-Meter circuit used in the July 61 issue of *73* can be incorporated with the output circuit.

The best place to put the meter is in the space now occupied by the Heathkit emblem. Center the meter hole in the clear space there and cut away. A masonite hole cutter will go through the aluminum front panel like it was cheese, by the way. Connect the meter through a variable resistor to meter jack Z. See Fig. 1. The pot can be taped to the back of the meter and used to "set" the meter. Run the ground lead from the meter to the ground lug on the neon light terminal strip just below it and you're all set.

One possible cause of feedback in the

Two'er is the long lead between the modulation transformer and final. Replacing this lead from terminal strip N1 to strip S4 with shielded cable cleared up the feedback problem for WA2FFB and K2GHU, it could for you, too.

The screwdriver adjustment on the regen control was a bother so I replaced the pot with one with a small knob.

The phone plug used for an antenna jack is fine for base station use, but if you do any mobiling you'll find that the antenna cable keeps pulling out of the phone jack. The best connector to replace the phono jack is the Dow-Key Model DK60-P panel mounting coax connector. All you have to do is enlarge the old antenna jack hole and screw the new Dow connector in.

If you switch between mobile and fixed station use a lot, the chore of changing fuses can trip you. Forget to place a 8 amp mobile fuse in and the 1½ amp ac one will blow. Forget to put back the 1½ amp fuse when you take the rig out of the mobile car and you lose your fusing protection. WA2WZP got around this by putting a fused line plug on the ac cable and leaving the mobile 8 amp fuse in the Two'er. This way the proper fuse is always in the rig whether the ac or mobile cables are used.

If you desire to make the Two'er transmitting audio even better you can use this modification that worked wonders on WA2UCG and WA2WZP's Two'ers. Remove pin 3 of V1B (12AX7) from ground and connect a 680 ohm resistor and .01 mfd capacitor between it (pin 3) and ground. See Fig. 2. Remove the .001 mfd capacitor (C41) from pin 2 and ground and replace the 10 megohm resistor from pin 2 to ground (R26) with a 1.2 megohm resistor. The audio really sounds great after this simple revamping.

When I'm asked how the Two'er works I always say that the transmitter is a dream and the receiver is a nightmare. While the receiver isn't quite that bad, the broadness of the superregen circuit does make for interesting contacts when the ham down the street comes on with his 200 watts and a whole megacycle of band disappears. To make the

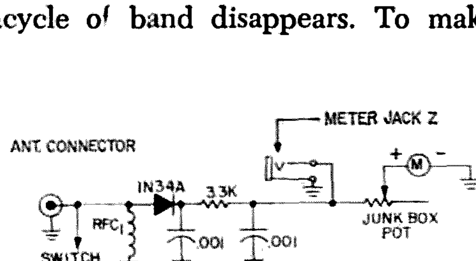


Fig. 1. Addition of tuning meter.

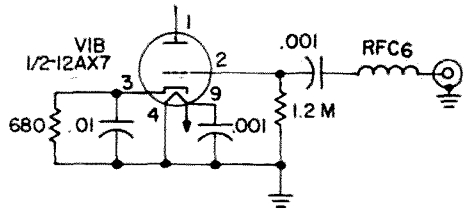


Fig. 2. Audio changes.

receiver more selective, change R10 to about 32 megohms. WN2HQE dug up the modification when he was borrowing my rig and "jerried" it in with four resistors that gave the best results. The precise value will be different for each rig but in all cases L6 will have to be retuned because the resistor(s) will change the calibration. Better yet see the June '63 issue of 73 for a fantastic improvement. You'll need a vernier after this one!

If you have a base receiver the next step in improving your two meter setup would logically be the building or buying of a converter. I've always had one switch operation and the Two'er/converter set up was no exception. One switch operation boils down to having the Two'er TR control operate a relay that changes the antenna from Two'er to converter and mutes the receiver. If contracts 2 and 3 of the Two'er's TR switch were used to activate a TPDT relay the problem would be solved.

With just a little planning, and one terminal strip, changing between using the Two'er barefoot or with a converter can be simplicity itself. Screw a 5 lug terminal strip under the mounting screw of tube socket V4 so that the strip faces the center of the chassis. Clip the lead going from contact 2 of the TR switch to the red neon light and attach it to lug 5. Clip the lead going from contact 3 of the TR switch to the power neon light and attach it, after adding a jumper wire to lug 1 of the erminal strip. Now trace out the wire going from contact 2 of the TR switch to the bottom of coil L2. Cut the wire so that there is enough lead to reach from contact 2 to lug 4 of the terminal strip. Wire a jumper on the other half of the wire and attach it to lug 5. Cut the wire going from contact 3 of the TR switch and the B+ so that the switch end will reach lug 2 and the B+ lead will reach lug 1 of the terminal strip. By using the original wiring you save the TR switch contacts from harmful resoldering. For normal transceiver operation connect lug 1 to lug 2 and lug 3 to lug 4. For a Two'er/converter combination connect the TR relay control wires to lug 2 and 4 while connecting a pair of switched contacts to lug 1 and 5. Wires to the relay can be brought

out through the meter jack hole or, if you want a fancy job, the eight prong power plug can be exchanged with a ten prong one and the extra contacts used for the relay setup.

You could also connect a higher B+ relay, such as a surplus 100 volt job, between the plate of the 6BS8 and ground. With this set up the internally switched B+ would activate it. If you do so WA2WZP suggests you remove the 6BS8 for best results.

By the way, a perfect place to keep the Tower mike is under the handle of the top of the case. It keeps it safe from harm yet right at hand.

The Two'er has made two meters an easy to get on band. When you build the rig though, be sure to use a small soldering iron and small solder. I built the Two'er with a gun bigger than the case and had problems getting into the corners. The one bug that kept me from getting right on the air was a real dog. The one contact that Heathkit soldered to make sure it was done "right" was cold! So be sure to check everything if something goes wrong.

The Two'er is a nice little rig and with these changes it is a real pleasure to work with.

. . . WA2QZH

An SWR Bridge for the 32S-1

A false panel is set behind the perforated panel with a piece of black blotter between the two. The escutcheons are glued on the perforated panel with epoxy glue. On the right is a Knight SWR bridge. In the center is a 4" speaker. On the left is a Kwickpatch phone patch. Arrange the leads in the rear so the power pack can be removed without too much difficulty.

. . . W4NJF

EICO 722 on Six

Having an EICO 722 vfo and a desire to use it on 6 meters, I discovered that by returning the vfo, 6 meter operation is possible.

Since the vfo oscillates always in the 80 meter band and multiples are used for other bands, it is possible to have the vfo oscillate above 4 mc and double to 8 mc on the 40 meter band. The procedure is quite simple: (1) By turning the slug in coil L1 all the way down as far as it will go, you can raise the oscillator frequency on the 80 meter band so that when the dial on the vfo reads 4 mc, it is actually about 4.25 mc. Coil L4 is now adjusted for a peak S meter reading. (2) Now switch to the 40 meter band and adjust trimmer C6 for the second harmonic. Any receiver that tunes around 8 mc is satisfactory. I used a Hallicrafter S38E. After trimmer C6 is adjusted for highest frequency which should be around 8450 kc, coil L5 is adjusted for a peak S meter reading. This completes the conversion.

On my vfo I can now cover from 50 mc up to 50.75 which is sufficient coverage since most of the operating is done between 50.1 and 50.4. To use it on the low bands, all that is necessary is to follow EICO's instruction manual.

This conversion is ideal for those who lack funds and who do not want to ruin a good 80 to 10 meter vfo.

. . . WB2EPB

Neater Decals

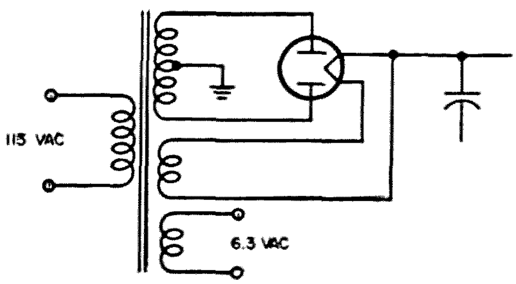
Most of the instructions furnished with panel marking decals tell you to spray the panel with clear spray after the decals are in place and dry. However I find that a careful application of lacquer thinner does the trick and does it better. By working carefully around the edge of the applied decals with a fine brush dipped in thinner, they will blend into the finish as perfectly as a factory job with no shiny area around them to give the gag away, especially on wrinkle finishes.

Applied in this way and without any further treatment or covering, they will withstand any normal abrasion, and if at some later date you wish to change any of the markings, you can remove any or all of them by going over them with a cotton swab dipped in lacquer thinner, and then apply new markings as required.

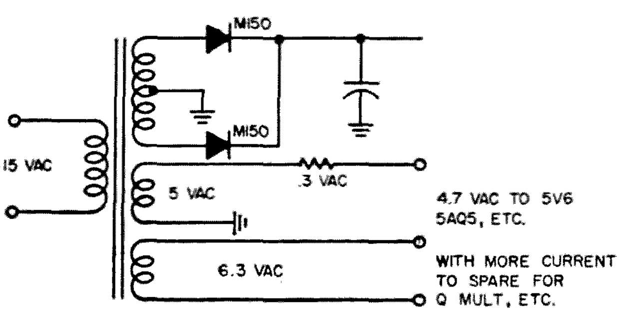
. . . WB2CCM

Transformer Tip

Statistics show that 99.44% of all amateurs /ho try to draw more than .15 a of filament urrent and 15 mils of B+ from their receiver ave gotten nothing but a charred power ransformer for their trouble. The alternative, separate power supply, is not much help o the fellow who wants to add internal ac- essories to his receiver. Fortunately, with the ise of silicon rectifiers, these pitfalls can be vercome. The conversion from tube to silicon ectifiers also results in higher B+ (because f lower internal voltage drop), less heat dissi-



BEFORE



AFTER

pation, and 5 volts at 2 or 3 amps of filament voltage becoming available. In the majority of cases 6.3 volts are needed for accessories. By changing some of the receiver tubes to their 4.7 volt counterparts, their filament current is made available. Most audio output tubes have 4.7 volt counterparts (5AQ5, 5V6, 5CZ5). A suitable dropping resistor must be added in series with the 5 volt winding. Make sure that the resistor is of adequate wattage! The current that formerly supplied the audio out- put tube can now be used to supply acces- sories. A good silicon rectifier for most re- placements is the Sarkes-Tarzian M-150. These rectifiers are very small and may be mounted n a standard fuse holder. If your normal B+ over 250 volts, use two in each leg of the ower supply.

. . . WA2KYF

Letter from Gus

As I write this, Dick YA4A (W4UTE) is at the mike operating YA8A. Dick is the SSB man on this trip, and I am CW (YA8H). We are just across a river from UI8 land.

Last week when we were YA9H and YA9A, we were across a river from UH8 land. At both spots we could see the barbed wire entanglements and guard posts with machine guns at each place. I wished I had had a pair of field glasses so I could have gotten a better look at what was happening across the river. I'm sure they had their telescope trained on us though.

Life sure has been interesting here the past couple of weeks. I am getting to parts of this country that are certainly off the beaten path. We have been eating and almost living off such items as honey dew melons as large as South Carolina watermelons, peaches, and man! these big blue and purple plums, some as large as your fist. These are the best I've ever eaten! There are oranges and tangerines, cucumbers, eggplants, apricots, and a number of other fruits and vegetables I don't recognize. The weather here is hot in the daytime, about 105 to 110, I guess, and it gets downright cold after midnight.

Conditions have been reasonably fair. The US east coast up to the middle west is worked in the mornings from about 0030 to 0300 GMT and a few west coast stations a little later. Europeans every night come in up to about 2130 GMT. We are operating around the clock, when the band is open, we are on the air. 21 Mc doesn't seem to open here much at all, just a few JA's and UA's and even less Europeans, two or three Africans . . . and that's 21 mc here. 7 mc is for the birds, with all the commercial QRM and the usual summer QRN. Sandstorm static is sometimes very bad, up to S7 or S8 every day from about 1400 to 1600 GMT.

You never see any clouds in the sky here, but we do have a few breezes blowing during the daytime and it's not bad if you can stay in the shade. The water in the river is too cold for me to go in swimming, but Dick goes in a couple times each day, and he comes out covered with goose pimples. They tell us that cholera is almost at the epidemic stage around here, so we are very careful of what we eat and drink. So far both of us are in the very best of health.

Dick is a fine fellow to go on a DXpedition with. Since he speaks this language, he is a *must* if you want to get anything done here. No one in this part can speak English, all signs are in the native tongue, and all is Dutch to me.

The ladies all wear veils and all you can see is their eyes through a little piece of thin cloth. Their dresses are down to their ankles. I'll bet that in this hot weather, when they get back to their houses and take off that veil, they say, "Am I ever glad to get that thing off!"

Our big problem here is transportation from place to place; usually it's by one of those beat-up busses. Occasionally we can find some fellow with a car and pay him to take us to the next spot. We have an eye on a Neutral Zone over here between YA and AP land, only a few miles from the Khyber Pass. We are trying to get some sort of word from Bob White W1WPO as to whether it would be a new one. We may go there anyway just for the heck of it, but since it's not owned by anyone, we are in a quandry as to what call sign to use if we get there. We'll come up with something though.

Tomorrow we QSY to YAO land, right on the border of UJ8/BY/YA. I expect as usual we will be watched. I understand this one is right up there in some mighty high mountains, which should be FB since it will remind me of Bhutan.

It's still W3CRA and W5VA, neck and neck. When they are S6, the band is closed to the States. When they are S7, you might hear a few weak Stateside stations. When they are S8, the band is reasonably fair, and when they are S9, the band is in good shape. I must inspect these fellows' stations and steal their secret so W4BPD will be in there with them when and if I ever get going again.

My Hy-Gain 14 AVQ vertical sure does look beat-up, bent, crooked, but believe it or not, it still has just about 1:1 SWR on all the bands from 10 through 40. But the shape it's in, I certainly would not put it up at home, because Peggy would run me back to Tibet! I tell the customs fellows that it's my deep sea fishing rod! And so far, they believe it too! I call the rig an SSB signal generator. I wish I had a turntable and tone arm mounted on it, and then I could tell them it's my record player. This would kind of speed up the usual customs delay. . . . Gus

VHF

Meteor scatter buffs watched the passing of the annual erseids meteor shower with varying thoughts. Some, such as /ØENC, said that the shower was poor. Others worked :veral states. K41XC in Florida added K1UGQ and W5UGO ı Oklahoma for two new ones giving John 29 states on two. ıther interesting QSO's: WØENC worked WB6KAP and /AØFDY for 30 states; WAØFDY worked K5TQP; W4WNH 'orked seven stations (W4AWS three times!), WØCUC 'orked W7PUA/2, K2RTH and K8AJF; KØCER QSO'ed /2AZL, W3BYF and VE3DIR.

One interesting thing is that all three South Dakota ıeteor stations worked stations only on an east west path nd all within an 18 degree beamwidth. Each station had ıany skeds in other directions, but very little was heard. ınyone else have this problem?

During each shower the question arises, "Did I work him?" 'wo meter DX men have been long known for their honesty n making valid contacts. Now just what is a contact? Ponder hat one for a minute. The consesus is that there must be n exchange of information. Going by that, merely exchangng calls and a "roger" would fulfill the requirement. Granted hat one for a minute. The consensus is that there must be his, two meter men have come to generally accept a form ·stablished by a W3 a few years ago. In it, four pieces ıf information have to be exchanged. Some of this I beieve to be repetitious. I refer to sending calls and a signal ·eport, then the signal report with a "roger," then a separate 'roger." The rules say you send the "r" until you receive an ng on this and are beginning to use the calls only, signal ·eport only and then the "roger" only.

This "roger" business can get silly very fast. You have ex- :hanged all the necessary information except the confirming "roger." The rules say you send the "r" you receive an "r." Okay, I'm sending an "r" to, say, WC2ABC. He re- :eives it and quits sending, but I may not have heard this "r." How many QSO's have YOU lost this way? On the other hand, if someone doesn't cease sending "r" when he copied "r" this silly exchange would go on, rogering the roger, rogering the rogering roger . . . you get the idea.

Some fellows send a 73 or SK after the "r" so the guy on the other end knows he got the two way "r." This is fine if there are still a few meteors around. I for one am going to send the "r" (if I get that far) until I hear an "r" and then I'm going to quit, get a cup of coffee and wait until the next sked. In my book, I've worked him. If you want an interesting discussion sometime, ask W1FZJ what he thinks on this topic. By the way, I'm braced for the flood of protests that will probably come my way after this discussion. As K5JKX would say, "What do you think?"

The next showers to try something new—and perhaps more reasonable—are the Orionids, October 18-23; Leonids, November 14-18 (they should be excellent this peak year) and the December 10-14 Geminids. Good pingin'.

Another form of propagation which could start to show some life this fall with the sun spots on the increase again is aurora. These signals, reflected off the Aurora Borealis (Northern Lights) usually peak around sundown and then return again about 2 AM. Distances covered can range from a few miles to several hundred miles. If you've never heard an aurora signal you won't believe your ears the first time you do. Next time WWV is sending a forecast of "W" or "U" followed by a number, swing your beam slowly across the northern sky and listen for something that sounds like a buzz saw going through one foot knotty pine. That is aurora! Incidentally, forget AM (and maybe FM) for aurora. Try CW or SSB.

The boys at project Oscar are looking for reception reports on the 145.95 mc coherent beacon. It has been reported by W60JW and other observers about 3 db out of the noise and 20 or more db down from the 145.85 mc beacon. If you hear it, tell them.

And don't forget to get that antenna work done now. It 'ill be cold before long and although antennas with hide 'ozen to them seem to work best, it's rough on the CW fist. on't forget to write.

. . . KØCER

advised by my lawyers that
don't you ever proofread y

Letters

have no other recourse but
should be tarred and feath

Peter Volpe, Ted Guernaras (Deputy Registrar), John McCarthy (Commissioner of Finance and Deputy Governor), Governor Volpe, Father Dan Linehan, Pat Volpe, Bob Waters, Russ Ringland

Dear Wayne:

The issue of call letter plates to all the amateurs in Massachusetts was announced at the ARRL New England Division Convention in April of this year when it was announced that Father Dan WIHK would receive the first set of plates. On the second of June we were told that the Registrar had decided to issue license plates as public service plates at no extra charge to all amateurs in Massachusetts. We were asked to furnish him a list of amateur radio operators who wanted plates by June 15. As we didn't have the time to make a direct mailing to all amateurs in Massachusetts, we decided the only way we could do it was through the use of Amateur Radio. After all *we are communication people.* (We were asked not to use the newspapers). With the help of FEMARA, The Quannapowitt Radio Association and many other amateurs and nets, we turned in a list of 2018 amateur calls to the Registry. Many more than the seven or eight hundred they expected. These plates are being issued for 1965.

Our thanks to all the amateurs and their communication systems who made this endeavor so successful.

The License Plate Committee
Russ Ringland WIEYZ, Chairman

Dear Wayne:

The 1215'er (May) is the greatest thing since the APX-6, and twice as much fun. Thanks for renewing my interest in home brewing. Keep up the sarcasm, too! !

Jim Waldorf WA8GAJ
Canton, Ohio

Dear Wayne:

I would like to take this opportunity to say that I agree thoroughly with your editorials and views concerning the ARRL. *Oscar* was one of the greatest opportunities amateur radio has ever had to receive favorable public recognition. The league should practice what it preaches. In the April 1964 issue of *QST* W8GUL wrote an article entitled "Come Blow Your Horn." The author says that "publicity must be persistent and regular." All the other satellites get publicity, why not Oscar? Those amateurs who take pleasure in writing you nasty letters should consider points such as this seriously.

Your surplus conversion articles were superb. Keep up the good work.

Neale C. Hightower WA4NAI
Charleston, S. Carolina

I take it back, Neale, Oscar II finally did get some publicity. The June 22nd National Review had a nice little nine line squib on it. I'll bet Barry sent it in for them . . . hi

ıear Wayne:

I want to spout off about our local form of democracy ı evidence during my recent encounter with the local lanning Commission. To make a long story short, I pplied to the local County Planning Commission for a ariance to the height restriction in the zoning ordinance. 'he zoning limit is 35 feet but I requested a variance of nother 6 feet so I could erect a crank-up tower. The lanning Commission decided there should be a public earing on the matter, so I prepared my case complete with hotographs, diagrams, design computations, reference ooks, Weather Bureau wind roses (to show the prevailing 'inds), proof of liability insurance, and anything else I ɔuld think of to support my case. The fellow living behind ıe was objecting so the Board gave him time to make is statements which he did not have to prove. When it 'as time for my side, I started presenting my side but the ıoard (2 members) cut me off saying time was running ut and my request was denied.

My Attorney has advised me to procede with the building ermit up to the 35 foot zoning limit because the objections 'ere not valid. While applying for the permit I got a hance to see the letter that was filed objecting to my re- uest. He had made several points which could have been efuted if someone had bothered to check the objections gainst my application but I think that the last objection vas a real gem. My antenna could be used by enemy air- raft or missles to home in on. Hi.

Anyway, this is what happens when you try to follow ocal building ordinances and do everything by the book. Have to say 73's for now and get busy on my homing ıeacon. Hi.

Richard M. Schreiner WA7ACN
Portland, Oregon

Dear Wayne,

When I visited K2US, after walking through hallways ınd up stairways, I was confronted by a picture window ınd a locked door. When I knocked on the door the lone ɔperator looked up and shook his head. I continued to knock and he came to the door, opened it a crack and said I couldn't come in until I got rid of my Coke. I drank it, walked back down the hallway to a receptacle and returned. I was then allowed to enter. I asked what band he was working and he said "none." He called a short CQ (no answer) and I again asked him what band he was using. The reply again was "none." I asked for a QSL card and was refused. I asked to sign the visitors register and was refused when I mentioned that I did not yet have a license. I think I would have been received better at a Moscow amateur radio station.

John English
Sherman Oaks, California

V	T	V	M				M	E	T	E	R
A	T	I	O	S		B	E	C	O	M	E
C	■	P	O	T		E	G	O	■	E	I
U	T	■	N	O	D	E	S	■	P	E	G
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P	I	C	A	■	L	O	S	E	R	S	
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R	K	■	C	L	O	U	D	■	B	A	T
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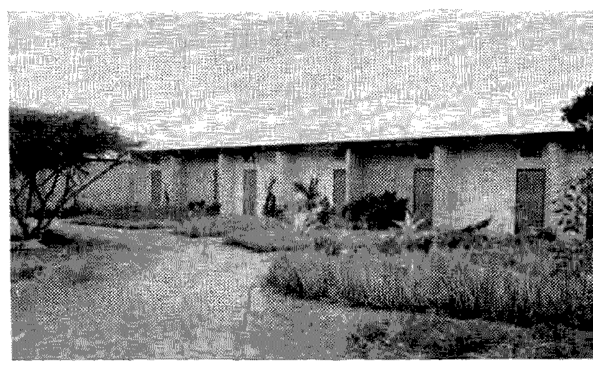
Y	R	O	L				T	O	N	E	

Continued from page 2

him to watch out for me. Since I waited until the last minute, as I usually do on things like this, I was very grateful when I got a call on twenty from PJ3CD and instructions on how to get a license when I arrived. It seems all I had to do was send a copy of my U.S. license down to Chet and everything would be taken care of for me.

There are only a couple of flights from Puerto Rico to Curaçao a week, so I had to make do with one that left late at night and arrived near midnight. They were right there to greet me and drive me to the hotel, even so It was quite a drive out there because Chet picked a completely isolated area to build his hotel.

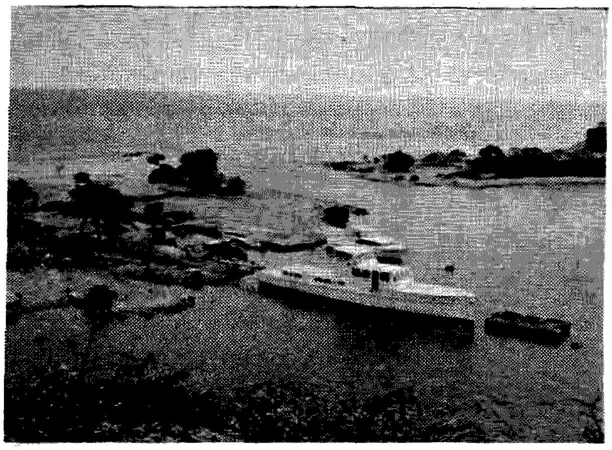


The hotel is quite different from what I had expected. It is made up more like a motel, with five buildings, each with seven rooms. The rooms were large, nicely furnished, air conditioned, had beautifully done bathrooms with showers and tub, and a private balcony overlooking the Caribbean. A few steps away from the rooms is the recreation building . . . something like a hotel lobby with lots of chairs and couches for sitting and talking and playing games . . . plus the ham station with a picture window in front of it looking out to sea. The next building over was a dining room and bar.

Chet had the OK for my ticket and I spent a good deal of time operating PJ3CC. I did get out for some skin diving and a sail. They have facilities for water skiing, deep sea fishing, tennis, and all that sort of thing, but I'm afraid that most of my time was spent on the rig and eating. Good food.

Chet tells me that he is going to be pretty crowded this winter so you might plan well ahead if you want to visit there. Chet, with his brother and their wives run the place and it is a nice family atmosphere.

The weather was fine when I was there in late July . . . about 90° temperature and 70% humidity. It was very comfortable for taking



t easy and for water sports.

I did take one day off and visited town. onas PJ3CD quickly arranged a hamfest and ight PJ's came over that evening. We had a ery enjoyable talk which didn't break up ompletely until after 2 am. The next time ou work PJ2CD, PJ2CE, PJ2CO, PJ2CR, J2CZ, PJ3CB, PJ3CD, or PJ3CH give them egards from Wayne.

You can bet that I'm going to get to Curaçao about 40 miles north of Venezuela) again as oon as I can.

Skin Diving

While I was down in the Caribbean area doing the piece on the Arecibo dish and the Coral Cliff Hotel, it seemed like a waste not to stop over and say hello to Dick Spenceley KV4AA and, heh, heh, go on a short skin diving trip while I was there visiting.

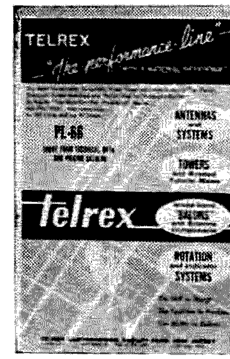
Dick is doing well. He reports that he has finally managed to kick the DX habit, at least to the extent that he can allow a new country to get on now and then without his having to be the first to work it. Dick was a little vague, but I think that there are a couple that he has completely missed recently.

So there's this little (65 foot) boat that goes for a one week skin diving trip every other Monday out of St. Thomas. There were seven of us along as passengers plus four crew and we cruised all through the British Virgin Islands and had a very good time. The chap in charge of the skin diving (John) turned out to be an old acquaintance . . . we'd gone diving together in Bermuda about eight years ago. I haven't been skin diving for about six years, so it was particularly enjoyable to get back in the swim.

Unfortunately the boat only had 32 vdc so I didn't bring along a transceiver . . . maybe next time.

. . . W2NSD

NEW PRODUCTS

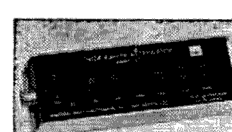


Telrex Catalog

Telrex Laboratories' new PL-66 short form catalog contains lots of interesting goodies. They have antennas for all bands, from an eleven element yagi for 432 to a three element optimum spaced beam for 40. They also have Duo-, Tri- and four band beams and some CB antennas. Not to mention the broad-band baluns, inverted V kits, masting and very heavy duty rotator. Send now: Telrex, Asbury Park, N.J. 07712.

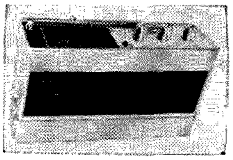
Kit-of-the-Month

Here's an interesting idea. The Kit-of-the-Month Club offers a different electronics kit each month for a low price. The kits are simple and easy to make, so are ideal for beginners and those with limited experience, yet could be a lot of fun for old hams as well. Incidentally, you don't have to buy a minimum number of kits. Get more information from KOTMC, P.O. Box 44718, Los Angeles, California 90044.



Waters Attenuators

The new Waters wide range attenuators provide up to 61 db of attenuation in 1 db steps. They may be used to check S-meter calibration, relative signal levels, antenna gain, front-to-back ratio, receiver sideband suppression, image and *if* rejection, and measure filter respone. Maximum power is ¼ watt and VSWR is less than 1.3 from DC to 225 mc. The model 371-1 with UHF connectors is $27.95 and the 371-2 with BNC's is $29.95. For more information contact Bob Waters at Waters Mfg., Wayland, Mass.

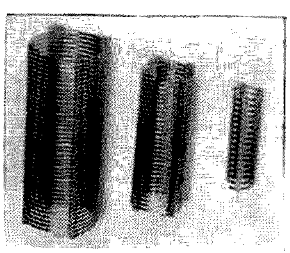


Lafayette 6 Meter Transistor Transceiver

Lafayette has introduced their model 650 Solid-State 6-Meter Transceiver for only $119.95. The fully modulated transmitter features 1.5 watts output with 6 crystal controlled channels (8 mc crystals.) The tunable receiver covers 50-52 mc with a sensitivity of 1.2 μv and a series gate noise limiter. It uses a zener voltage regulator and can easily be operated fixed with the external antenna connector and optional 115 vac power supply. Other features telescoping whip, S-meter, relay switching, PTT mike, carrying case and shoulder strap. Write Lafayette, 111 Jericho Turnpike, Syosset, N.Y. for information and a catalog and tell them where you saw it.

TUCO Catalog

TUCO has a fantastic catalog of semiconductors, subminiature components and electronic kits. Many of these parts aren't available elsewhere—at least, not at the reasonable prices TUCO offers. Among their products is a completely built regulated power supply that furnishes 12 volts at 1 amp and costs only $15, and a 12 watt transistor amplifier for only $20. Be sure to write and get their catalog if you do any building and experimenting. Transistors Unlimited, 462 Jericho Turnpike, Mineola, N.Y. 11501.



PIC Air Wound Coils

Polyphase has developed a new line of 55 standard types of air wound coils for many ham and industrial uses in transmitters, receivers and other equipment. The Polycoils feature special "D" section supports for minimum power absorption for lower losses and higher Q. They are available in lengths up to 10", diameters from ½" to 3", and pitches from 4 TPI to 24 TPI. Special larger Polycoils and variable Polycoils with ratings to 15 KW are also available. Write for bulletin CP1001, Polyphase Instrument Company, Bridgeport, Pa.

Caveat Emptor?

★ Price—$2 per 25 words for non-commercial ads; $5 per 25 words for business ventures. No display ads or agency discount. Include your check with order.

★ Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.

★ We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.

★ For $1 extra we can maintain a reply box for you.

★ We cannot check into each advertiser, so Caveat Emptor . . .

CQ LIBRARY for sale. Sept, Oct 1953, May, June, July, Sept, Oct, Nov 1954, All but Feb-Dec 1955 and 1956 through 1964 solid. Will ship. F. J. Krauss W8SPR, 906 Morris St., Salem, Ohio 44460.

TTY CHANNEL FILTERS, new surplus Northern Radio, 595, 765, 2635 cycles. 2 for $5. Audio filters, 300 to 3300 cycles, UTC 500 ohm, 20 watt 2 for $5. Lock City Electronics, R. 1, Sault Ste Marie, Mich.

C. FRITZ back on the job! Bringing hams greater QSL returns over a quarter century! Samples 25¢ deductible. Box 1684, Scottsdale, Arizona 85252 (Formerly Joliet, Illinois.)

SELL/TRADE: Complete parts for KW linear. 2-813's, 2-866A's. 10-80m. Cost over $175. Other items. Stephan Clifton WA2TYF, 800 West End Avenue, New York, N.Y. 10025.

RCA 6V FM30-44 mc. 60 watt model MI transceivers. Complete with heads, mikes and cables. $35. Sid Nelsen, Leeds, N.D.

QST LIBRARY for sale or trade. Sept 1953, all but Jan, Feb, April, Aug 1954. 1955 through 1964 solid. Will ship. W8SPR, Morris, Salem, Ohio.

GALAXY 300 with AC power supply in excellent condition, $275 FOB Sacramento. Tony Assenza, 10724 Campana Way, Rancho Cordova, Calif.

QSL SAMPLES?? 25¢ (Refunded.) Russ 73 Sakkers W8DED, Holland, Michigan.

RADIOPHONE 44 PANADAPTOR. Ideal for Collins or any other 455 kc if receiver. Also will monitor transmitter. Will take best offer! Walter Reid, VA Hospital, Wood, Wisconsin.

PREPAID USA: Heathkit HM-11, $10; MT-1, $45; HX-20, $140; HR-20, $90; HP-20, $23; HP-10, $35; SBA-300-3, $15; SBA-300-4, $15; Eico 147A, $33; 950B, $20; 352, $10. Will consider any offers. W9FQC, 1612 W. Columbia Terrance, Peoria, Ill.

KNIGHT T-60. Excellent condition with five Novice crystals. Real nice Novice transmitter. $35 plus shipping. Ron Hallmark, 656 Rothrock Ave., Attalla, Ala. 35954.

COLLINS 32S3 $500. 516F-2 power supply $75. 75S $450. Lot price $975. RTTY model 28RO $150. Delivered 150 miles. K9HUK, RR1, Box 303v, Brownsburg Indiana.

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432 MC PREAMPLIFIER. 5 db noise figure, 17 db gain transistor. Great for ATV. Ready to go, $12.50. Two for $23. W6ORG, 10253 E. Nadine, Temple City, California.

SX-111. Almost new, $155. DX-60, ½ year old, $50. Box $200. Want Galaxy V with AC. Will trade, WN6OGG 3171 Walker, Rossmoor, California 90720.

GALAXY V, 115/230 volt supply, deluxe console, VOX, calibrator, remote VFO, $695 new, take $495. 75A1 speaker, excellent $85. Don Payne W4HKQ, Box 525, Springfield, Tenn.

MOSLEY 10-20 vertical, $10; used 14AVS, $15; Webster Band Spanner and chain mount, $15; Heliwhip 6 meter cowl mount, $10. KØDQG, Box 156, Boone, Iowa.

GONSET COMMUNICATOR III. 6 meters, PTT mike, 110 vac and 12 vdc, 3 crystals. Immaculate. $120. WA9BYR, 627 Dundee Avenue, Barrington, Illinois.

COLLAINS 75S3, $400; RME 4300 with RME 4301, sideband adapter, $100; Utica 650 with matching VFO, $100; HT33 modified to HT33B, $235; HT37, $240; BC221M with matching calibration book and built-in power supply, $45; DB22A pre-selector, $20. W4ZRZ, P.O. Box 6742, Birmingham, Alabama 35210.

HG-10 VFO and PS $20, Dow Key DK60-G2C $8, Ameco CN-144 two meter converter and PS $35, Gonset code oscillator and CW-phone monitor $12, 5 position coax switch $5, IO-12 scope $45, manuals. Prefer local deal. Jim Minikel WB6MQE, 517 East Emerson, Monterey Park, Cal. 213-280-8202.

FLATBUSH RADIO CLUB—AUCTION, October 18th, 8 PM, at the Sgt. Meyer Levin Hall, 1628 East 14th Street, Brooklyn, N.Y. For information call 771-5852.

ART-13, $40. BC-348, AC power supply, $50. 4-amp variac, $5. 10-henry 500 ma. filter choke, $5. Dave Babcock, WA2RJY/2, 397 California Avenue, Uniondale, N.Y.

CONVERT Command Xmtr to 100+ watt Transverter. Work AF MARS, CAP. Your hamband SSB Transceiver as exciter/receiver. Simple, Inexpensive. Plans-Schematics $1.25. W5NSN

HEATH HW32 w/cal, Knight T-60 xmtr, Eico 722 VFO all mint condx, best offer, WB2IIA 2574 Wallace Ave. Bronx TU26693

MONITOR SCOPE: Heath HO- 10. AF-RF Trapezoid pattern monitoring. New; less than four hours use. $45 G. L. Wettlaufer, Box 422, Almond, N.Y.

FREE Sales Catalog—laboratory and microwave test equipment—including military types. Wanted—your surplus equipment, tubes, components. LECTRONIC RESEARCH, 715-17 Arch St. Phila., Pa. 19106 215-627-6771.

S & H GREEN STAMPS. Needed for Missionary Ham Station. Have your friends help too. Father Jude, WA2YNO, St. Paul's Abbey, Newton, New Jersey 07860.

KIT-OF-THE-MONTH CLUB, New, unique, low cost electronic kits for novice or advanced hobbyists. Free information, Leader Enterprises, Box 44718-KF, Los Angeles, Calif. 90044

TWO TONS of Equipment and Components must go. Send for list. SB300, all filters and speaker, ex. condx. best offer over $285. G. Petrilak K2SWI 132 Fifth Ave. Kings Park, N.Y. 11754

TELETYPE TEST SET I-193C. Government rebuilt, still crated. Tests RTTY transmitters, converters, relays, $14.95 each, two for $27.40. F. O. B. Harrisburg, Pa. Satisfaction guaranteed. Telemethods International, 3075 E. 123rd Street, Cleveland, Ohio 44120

TV CAMERAS. Model 400 complete with good vidicon and lens. Used as demonstrators. Only $200 F.O.B. Vanguard Labs, 190-48—99th Ave., Hollis, N.Y. 11423.

TELETYPE SH25A tape unit, new, never used, works perfectly. I have no use for it. $100. David Edsall, W1TDD, 3 Berkeley St., Cambridge, Mass.

RTTY gear for sale. List issued monthly. 88 or 44 Mhy toroids. Five for $1.75 postpaid. Elliott Buchanan, W-6-VPC 1067 Mandana Blvd., Oakland, California. 94610.

QSLS—New designs—$2.55 per 100 postpaid in U.S.A. Samples 10¢ K9RFZ PRESS, 1127 Eastman St., Oshkosh, Wis. 54901

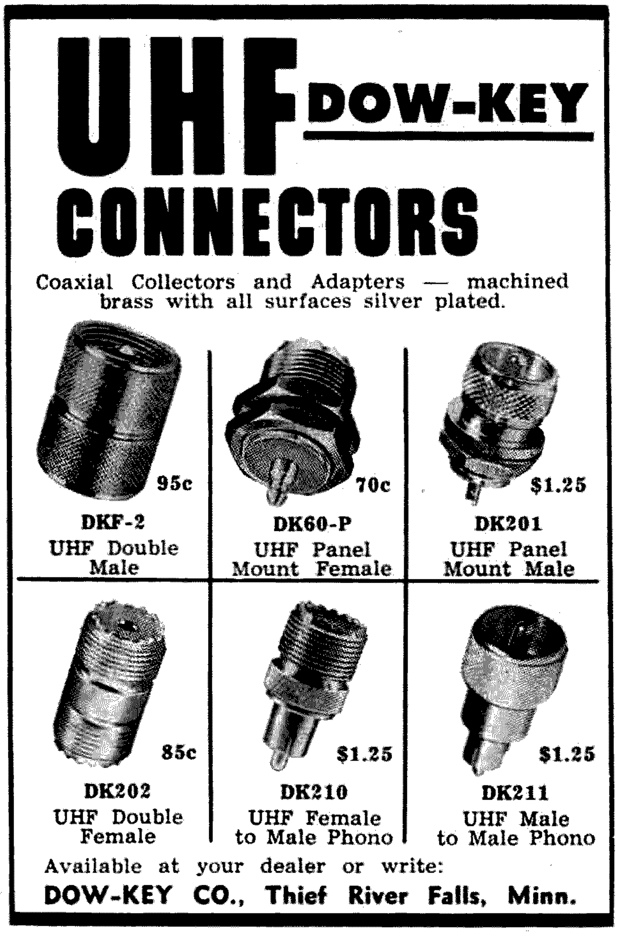
FM FOR 2, 6 AND 432. GE 12 volt, 40-50 mc receiver-transceiver 4ER6-4ET5, 30 watts output. Transmitter are fully narrow-banded but easy to wideband. These units were removed from service this year and are clean and in excellent operating condition with all accessories except antenna $39.95. 432 mc transceivers three frequencies, 12 volt, 15 watts output from 5894 tripler and 5894 amplifier. Complete with all tubes, accessories to put receiver on 432.9 mc. Five pages of information. $28.85. Same rig, but may need minor repairs $17.50. Less 5894's and accessories $5.50 each. 5894's checked and guaranteed $6.50 each. Manuals for 432 mc rigs $2. Motorola T44A6A, all tubes and accessories, $50.00. Motorola 41V front mount, 12 volt operating on 146.94 mc. Excellent complete, $95.00. Motorola Handie-Talkie on 146.94 (FHTRU1VDL) with batteries and operating, $65. Motorola transistorized 136-174 mc pocket receiver (17 transistors) with one watt pocket transmitter (2 transistors, 8 tubes, vibrasender) HO3ANC-XH23NAC, fully narrow banded, excellent condition, $125. Motorola 150 mc base station (desktop) $95. Motorola 150 mc, 250 mc output transmitter complete (will not ship this one) $150.00. Also Motorola T43-GGV-1. Wanted: Wheatstone Perforator, lab type test equipment-HP, GR, etc. two way equipment, Motorola, GE, etc. All items shipped FOB Trenton. Ray Newsome K8TJP, 2670 Pinetree, Trenton, Michigan 48183. Phone 313 -676-7460.

HARS HAMFEST in Rowlett Park, Sunday October 17. Lots of prizes, swap tables, free lunch. Plenty of free parking. P.O. Box 8373, Tampa, Fla.

GREATER BAY AREA HAMFEST, Peacock Gap Country Club, San Rafael, Cal. October 16 and 17. More information from WA6QVS, P.O. Box 113, Hayward, Calif.

WE WILL PAY CASH. Wanted-popular, late model unmodified amateur equipment. Highest prices paid for clean, good, operating gear. Write Graham Radio, Dept. 10, Reading, Mass.

ARE YOU SINCERE? Are you really looking for the best deal on a new or fully guaranteed used unit? Let us convince you with a specific quote that will really save you money. Graham Radio, Dept. 10, Reading, Mass.



INDEX TO ADVERTISERS

Propagation Chart

October 1965

J. H. Nelson

EASTERN UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7*	7	7	7	7	7	7#	14	14	14	14
ARGENTINA	14	7	7	7	7	7#	14	21	21	21	21*	21
AUSTRALIA	14	7#	7#	7#	7#	7	7	14	14	14	14	21
CANAL ZONE	14	7	7	7	7	7	14	21	21	21	21*	21
ENGLAND	7	7	7	7	7	14	14	14	14	14	14	14
HAWAII	14	7*	7	7	7	7	7	7#	14	14	14*	14
INDIA	7	7	7#	7#	7#	7#	14	14	14	14	7#	7
JAPAN	14	7#	7#	7#	7#	7	7	7	7#	7#	14	14
MEXICO	14	7	7	7	7	7	14	14	14	14	21	21
PHILIPPINES	14	7#	7#	7#	7#	7#	7	14	14	7#	7#	14
PUERTO RICO	7	7	7	7	7	7	14	14	14	14	14*	14
SOUTH AFRICA	14	7	7	7#	7#	14	14	21	21	21	21	14
U.S.S.R.	7	7	7	7	7#	7#	14	14	14	14	7#	7
WEST COAST	14	14	7	7	7	7	7	14	14	14*	14*	14

CENTRAL UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	7	14	14	14	14
ARGENTINA	14	7#	7	7	7	7#	14	21	21	21	21	21*
AUSTRALIA	21	14	7#	7#	7#	7	7	14	14	14	21	21
CANAL ZONE	14	7	7	7	7	7	14	21	21	21	21*	21
ENGLAND	7#	7	7	7	7	7#	7#	14	14	14	14	7#
HAWAII	14	14	7	7	7	7	7	7#	14	14	21	21
INDIA	7	7#	7#	7#	7#	7#	7#	14	14	14	7#	7
JAPAN	14	14	7#	7#	7#	7	7	7	7#	7#	14	14
MEXICO	14	7	7	7	7	7	7	14	14	14	14	14*
PHILIPPINES	14	14	7#	7#	7#	7#	7	7	14	7#	7#	14
PUERTO RICO	14	7	7	7	7	7	14	14	14	21	21	21
SOUTH AFRICA	14	7	7	7#	7#	7#	14	14	14*	14*	21	14
U.S.S.R.	7	7	7	7	7#	7#	7#	14	14	14	7#	7#

WESTERN UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	7	14	14	14	14
ARGENTINA	21	7#	7#	7	7	7	7#	14	21	21	21	21*
AUSTRALIA	21	21	14	7#	7#	7	7	7	14	14	21	21
CANAL ZONE	14	7	7	7	7	7	7	14	21	21	21	21
ENGLAND	7#	7	7	7	7	7#	7#	14	14	14	14	7#
HAWAII	21	21	14	7	7	7	7	7	14	21	21	21
INDIA	14	14	7#	7#	7#	7#	7#	7	14	14	14	14
JAPAN	14	14	14	7#	7#	7	7	7	7	7#	14	14
MEXICO	14	7	7	7	7	7	7	14	14	14	14	21
PHILIPPINES	14	14	14	7#	7#	7#	7	7	14	7#	7#	14
PUERTO RICO	14	7	7	7	7	7	7#	14	14	14	21	21
SOUTH AFRICA	14	14	7	7#	7#	7#	7#	14	14	14*	14*	14
U.S.S.R.	7#	7	7	7	7#	7#	7#	7#	14	14	7#	7#
EAST COAST	14	14	7	7	7	7	7	14	14	14*	14*	14

\# Very difficult circuit this hour.

* Next higher frequency may be useful this hour.

Good: 1, 2, 6-10, 15, 16, 18, 19, 24-26

Fair: 3-5, 10-14, 17, 20, 23, 27-30

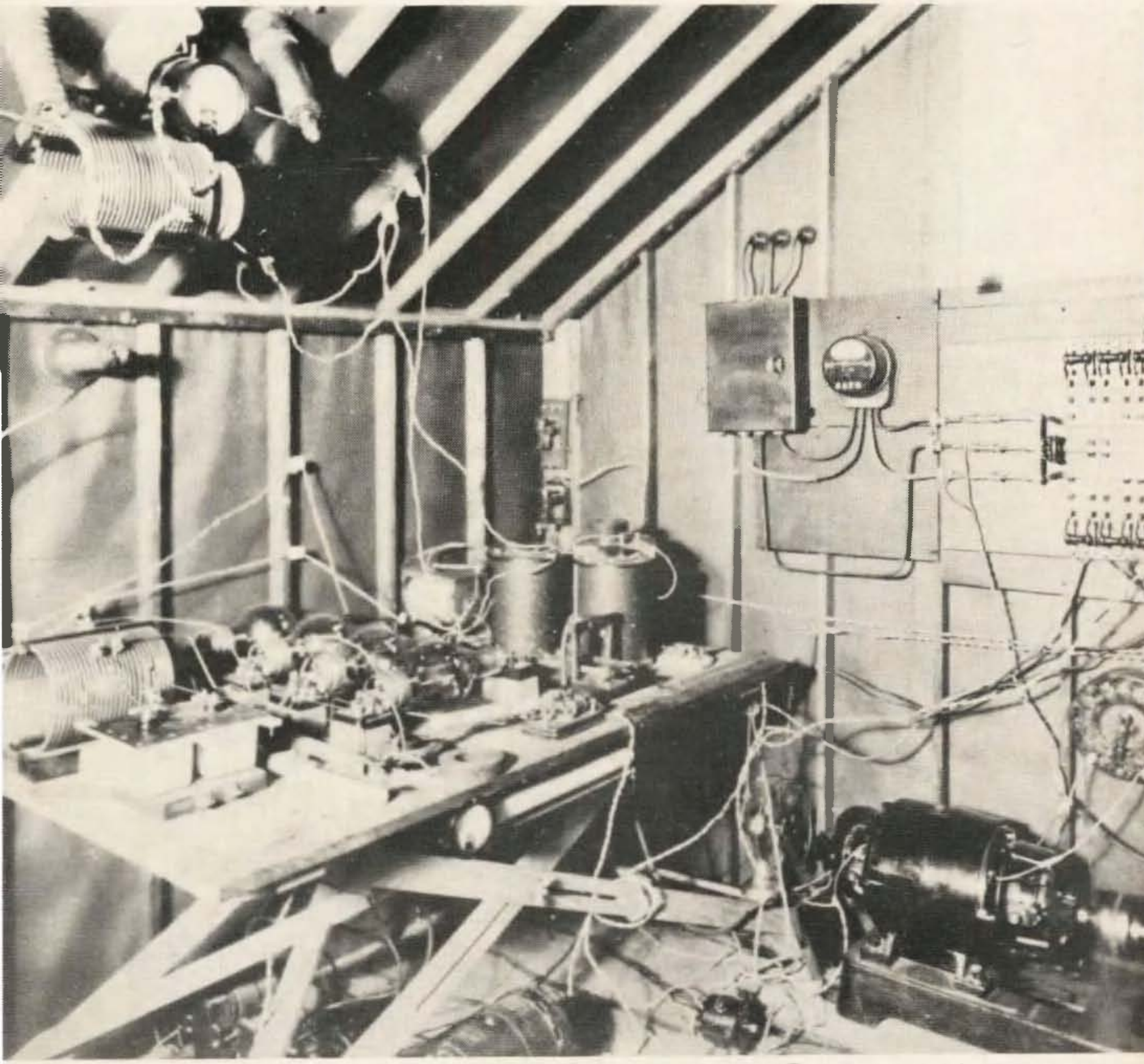
Poor: 21, 22, 31

VHF DX: 1, 9, 15, 26-30

73

NOVEMBER 1965
A Special 50¢

Amateur Radio



Devoted to Home Construction

73 Magazine

Wayne Green W2NSD/1
Editor & Publisher

Paul Franson WA1CCH
Assistant Editor

November, 1965

Vol. XXXVII, No. 1

'3 Magazine is published monthly 'thank heavens it's not weekly) ıy 73, Inc., Peterborough, N. H. ːip 03458 (terrible number). The ıhone is 603-924-3873. Subscription ates $4.00 per year, $7.00 two years, ·10 three years world wide. Second lass postage is paid at Peterborough, ·lew Hampshire and at additional nailing offices. Printed in Bristol, ːonn., U.S.A. Entire contents copyight 1965 by 73, Inc. Postmasters, ılease send form 3579 to Good Old 73 ·lagazine, Peterborough, New Hamphire. Use your Zip Zone and save ·ur shirt.

de W2NSD/1

never say die

Code

While most of you have agreed with my views on code as stated a couple months or so ago, a few took issue with me. Perhaps I should have been more explicit at that time.

At the present time it is the code exam that largely determines whether we get our amateur license or not, not the technical exam. I feel that this is the wrong approach entirely and that the deciding factor on the issuing of a license should be the passing of a technical exam, not whether someone has learned the code or not. Those of you who attended code schools during the war know that almost anyone can learn the code with a little practice. Perhaps the word "learn" is wrongly used here . . . it is a skill, not a learning process. If you practice long enough you will be able to copy code, no matter how smart or dumb you are.

My suggestion is this: stop using code speed as the major test for a ham ticket and take the emphasis off code. Fellows who enjoy CW operation will develop their code speed . . . those who don't will rapidly lose their skill anyway. Make a good technical exam the deciding factor for our licenses. Design the ham test so that it can be an open book exam that depends upon an understanding of the material and not the memorization of a bunch of "typical" questions in a license manual such as is published by QST and CQ.

While I refuse to devote the pages of 73 to publishing a glorified crib sheet for the FCC exams, I would be proud to back up sensible license exam program with a series on all of the fundamentals of electricity and electronics which would prepare anyone interested to pass an open book exam for any level of amateur license.

Huntoon Challenged

Now I don't know what pressure Huntoon put on the New York National Convention last year to force them to refuse to permit 73 to have an exhibit. I imagine it was considerable. Rumors have been persisting that he has flatly threatened the New England Convention Committee that if they permit 73 to exhibit at the 1966 Convention not only will the League not sanction it as a National Convention, but they will remove all ARRL support (including publicity and promotion in *QST*) from the event. The League did the same thing to the Cleveland National Convention when the committee invited Clif Evans K6BX to be present and the Convention was cancelled as a result.

It is unfortunate that the League is so small that they cannot stand to have anyone criticize any of their actions. Clif had the gall to be critical of Huntoon . . . and a National ARRL Convention was cancelled rather than permit him to talk to anyone. I too have had the temerity to speak out against some League actions and they are threatening to cancel another National ARRL Convention if I am permitted to have a 73 exhibit. I hope all ARRL members are proud of the League's reaction to criticism. Cowards.

The official attitude is that I am spreading lies and distortions. Both of us know that everything I have been saying is the truth. There is nothing that I would relish more than to have Huntoon face me personally in front of a Convention audience and ask me to my face to explain those things that I have written in 73 that he considers to be lies and distortions. He and I know that every single point that I have made can be backed up and that it is he that has to lean on out of

context quotes to even attempt to refute my statements. I say that the League cannot stand honest criticism and I challenge John Huntoon to debate with me in front of a Convention audience my criticisms of the League . . . without prepared written speeches, *please*. We don't want to sit and listen to John read two years worth of *QST* editorials verbatim, a favorite strategem of his.

Either I know what I am talking about or I am a fraud . . . let's uncover the truth once and for all. How about it John, have you the courage to back up what you have been saying about me in front of an audience?

In the meanwhile I predict that the New England Convention Committee will knuckle under to Huntoon and refuse to permit 73 to exhibit at the 1966 Boston ARRL National Convention. I will bet money on it . . . any takers?

ASRA

Several fellows have written me asking what I know about an American Society of Radio Amateurs, an outfit or person apparently soliciting funds from hams to fight incentive licensing. Since I have not had any correspondence from the "Society" I am *very* suspicious.

ARRL vs QST

A great many amateurs have a picture of the League that is similar to the one I used to have: a huge organization of nearly 100,000 amateurs plus a small group at HQ in Connecticut that puts out the monthly club magazine QST and other helpful publications.

A clearer picture of the situation can be had if you will take the time to send for the free ARRL financial statement. Reading this puts things into perspective and we see the huge publishing house of QST plus an almost insignificantly small ARRL which seems to have dwindled in importance to where it is now little more than an excuse for tax privileges for the giant publishing house. In looking at the 1964 statement of operating expenses we find that of the $1,407,000 spent in 1964 only $50,000 of this was expenditures authorized by the Directors. This comes to about 2.8% for the ARRL vs 97.2% for QST.

Apparently the mess that the ruling clique has generated is still lousing things up. Incentive licensing-RM-499-Docket 15928 has not only cost untold millions of dollars in lost sales to manufacturers and distributors, it has come back to undermine QST. The financial

(*Continued on page 120*)

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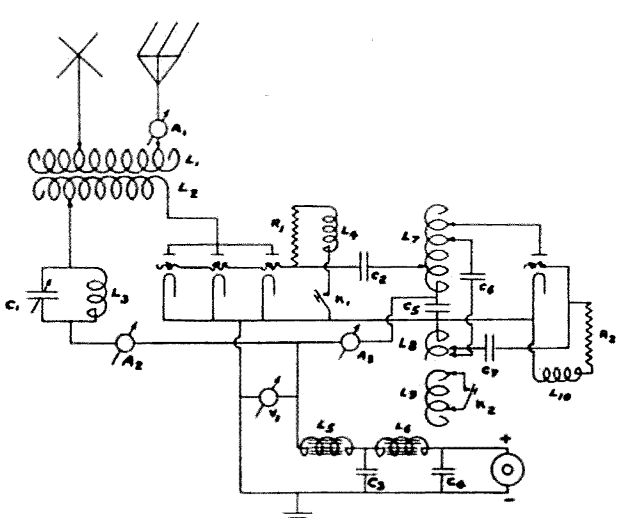
Catching up with the Past—No. 3

We Got Across

One of the greatest thrills experienced by amateurs occurred the night their signals left this continent and landed on another. It happened nearly forty-four years ago. Commercial interests will never forget it either. Using the "useless" frequencies thrust upon them by the Licensing Act of 1912, the amateurs on December 7, 1921, taught the professionals the value of the shorter waves.

Licensing forced the amateurs out of the "choice" commercial long waves into a region of unexplored frequencies. Hams didn't like the restriction at all. Begrudgingly they erected shorter antennas and reduced the size of oscillating components. However, the trouble they went to proved well worth their while: the shorter waves worked like magic. Where before they struggled to get out of backyards or beyond neighboring states, now they QSO'd districts lying far beyond their original range.



Circuit of the 1BCG transmitter built especially for the Trans-Atlantic Test by Edwin H. Armstrong, Ernest V. Amy, George E. Burghard, Minton Cronkhite, and Walker P. Inman.

East and West coast hams strained anew to work direct. But "lady luck" just wouldn't smile. In the meantime, many hams joined in the Transcontinental Relay tests conducted by the American Radio Relay League. The ARRL ran the tests to see how quickly the amateurs could relay messages from one Coast to the other and get answers back. By the time the record dropped from hours to minutes, announcement of a new contest set hamdom all afire—a test to see if amateur signals would hop across the Atlantic.

The attempt to span the Atlantic

Although the American Radio Relay League conducted the first Trans-Atlantic Test, they didn't originate it. The radio editor of *Everyday Engineering Magazine*, M. B. Sleeper, conceived the idea and completed all the arrangements. Under the plan, about twenty-five stations located in the first, second, third, eighth and ninth districts transmitted individually assigned signals. In the United Kingdom, Philip R. Coursey, Assistant Editor of *The Radio Review* in London, organized the listening end. Over 250 British Amateurs enrolled for the tests.

Just prior to the tests, near tragedy struck: *Everyday Engineering Magazine* suspended publication! Over night the whole plan hung in jeopardy. Was all the hard work and money put forth by amateurs and others on both sides of the Atlantic to go for naught? In a final effort to save the Test so nearly ready to start,

the editor of the defunct magazine called on the American Radio Relay League and asked them to take over. The ARRL readily agreed. However, time wouldn't allow them to inject any changes.

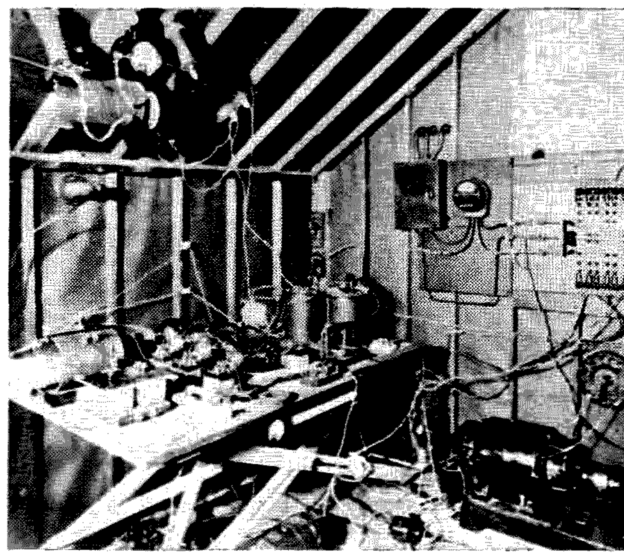
On the night of the tests, the American stations transmitted their pre-arranged signals. Prizes donated by manufacturers on both sides of the Atlantic awaited the best amateur performance. At the end of the tests, in accordance with the established plans, British amateurs submitted their logs for comparison with the confidential copy of the assigned signals. Would any jibe? Anxiously the hams on both sides of the Atlantic waited for the announced result.

Wireless World in England examined some thirty logs sent in by the British listeners. After a most careful check, the sad news came to light: The reviewers could not find one log containing a single word or signal that unquestionably matched the master copy of the assigned messages sent by the American stations. The First Trans-Atlantic Test failed.

Preparations for a second test

At the First National ARRL Convention held in Chicago August 30 through September 3, 1921, the Board of Directors agreed to a proposal by their Traffic Manager to hold a second Trans-Atlantic test. Now the ARRL set out to do what they couldn't do during the first Trans-Atlantic test—send an American dyed-in-the-wool ham to England with American apparatus. No shortage of time existed this time. The test planned for early December allowed three months for preparation. Spurred by the Traffic Manager's further suggestion that the ARRL send a good ham receiver-man to England to copy the American and Canadian signals, the Board voted the money to pay the amateur's expenses.

The ARRL wanted an American listener in England so they could expand the test into a big popular event without asking the British amateurs to stay up all night every night. Only American hams qualified for the "boiled owls" club. At the same time, the opportunity to work an American receiver in competition with British receivers would furnish an excellent comparison of sensitivity. A search went out for the best practical receiver man in the country; a man used to twirling a "mean variometer" all night long. The search ended almost before it started: Paul G. Godley stood out head and shoulders above the crowd. He adapted the Armstrong regenerative circuits to short waves, created the three-circuit tuner for amateur work, and originated the variometer



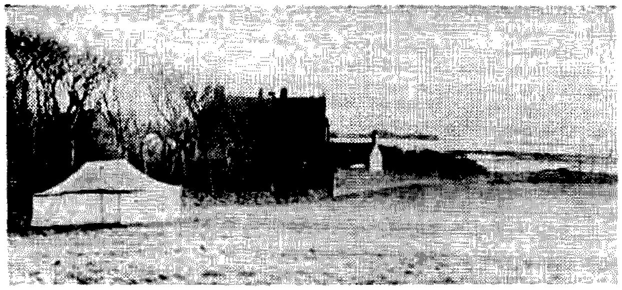
The 1BCG M.O.P.A. transmitter. A UV-204A oscillator drove three UV-204As in parallel. The motor generator supplied 2000 volts to the plates for a 990 watt input. Courtesy of the Radio Club of America.

regenerators that made possible the wonderful short-wave DX work in those days. When asked to tackle the job, Godley consented.

Amid the super-enthusiasm that greeted Godley's decision, the League dove right in to make the second Trans-Atlantic Test a controlled free-for-all. They divided the test into two parts. The first portion scheduled a 200-meter free-for-all by districts for all amateurs; the second part comprised a group of especially picked stations in each district assigned special wavelengths. To get in the second grouping, stations first passed a preliminary test conducted by the ARRL from November 1st through the 5th. All stations that showed proof they transmitted 1000 miles during that test qualified for the December test. Seventy-eight entered the preliminaries. Twenty-seven qualified.

The second Trans-Atlantic Test took place December 7th to the 16th inclusive. Tests during each of the ten nights lasted six hours. The free-for-all period ran from 7 pm until 9:30 pm EST broken up into ten periods of 15 minutes each. These periods assigned specific times for amateurs in the various inspection districts to call "test" and sign their calls. By rotating the periods daily no district sent the same time each night. Such an arrangement gave all the districts an equal chance in case some hours seemed more favorable than others. Canadian stations, due to their small number, entered as one district.

The second portion of the six-hour periods confined transmissions to the individual stations that qualified in the November preliminaries. Divided into fourteen periods of 15 minutes



The tent on the farm at Ardrossan, Scotland, in which Godley set up his receiving station. The Beverage-wire antenna ran from the tent down toward the beach. Courtesy of the Radio Club of America.

each, this half of the nightly tests extended from 9:30 pm until 1:00 am EST. Each station received sealed instructions from the ARRL assigning them secret ciphers to transmit and designating the time for each transmission. Sending times varied nightly like in the free-for-all half of the test. The selected stations represented all the United States districts plus eastern Canada.

To avoid accusations of unfairness, Godley possessed no more details of the test than the British amateurs. Both knew the free-for-all schedules. Later, Coursey gave the British amateurs and Godley the times of transmission and the special wavelengths of the selected stations. But only Coursey and the ARRL Traffic Manager knew the call letters and the ciphers. Like the British amateurs, Godley's instructions required him to send his daily logs to Coursey for verification with the master

Call	Location	Type	Wave	Cypher
1AFV	Salem, Mass.	C.W.	200	YLPMV
1TS	Bristol, Conn.	C.W.	200	AOTRB
1RU	W. Hartford, Ct.	C.W.	200	BPUSC
1DA	Manchester, Mass.	C.W.	200	CQVTD
1AW	Hartford, Conn.	Spk.	210	DRWUF
1BCG	Greenwich, Conn.	C.W.	230	GODLY
2BML	Riverhead, L. I.	C.W.	200	FSXVG
2FD	New York City	C.W.	200	GTYWH
2FP	Brooklyn	C.W.	200	HUZXJ
2OM	Ridgewood, N. J.	Spk.	200	JVAYK
2EL	Freeport, L. I.	C.W.	200	KWBZL
3DH	Princeton, N. J.	C.W.	210	LXCAM
4GL	Savannah, Ga.	C.W.	200	MYDBN
3BP	Newmarket, Ont.	Spk.	200	NZFCO
8DR	Pittsburgh, Pa.	C.W.	200	OAGDP
9KO	St. Louis, Mo.	Spk.	200	PBHFQ
9AW	Toronto, Ont.	C.W.	200	QCJGR
1ZE	Marion, Mass.	C.W.	375	RDKHS
2ZL	Valley Stream, L. I.	C.W.	325	TGMKU
3ZO	Parkesburg, Pa.	C.W.	360	UHNLV
5ZZ	Blackwell, Okla.	Spk.	375	VJOMW
6XH	Stanford U., Cal.	C.W.	375	WKPNX
7ZG	Bear Creek, Mont.	Spk.	375	XLQOY
8XK	Pittsburgh, Pa.	C.W.	375	YMRPZ
9ZY	Lacrosse, Wis.	C.W.	260	RZQMY
9ZN	Chicago, Ill.	Spk.	375	ZNSQA
9XI	Minneapolis	C.W.	300	SFLJT

These amateur stations qualified in the 1000 mile preliminary test, and operated as special stations in the second portion of the Trans-Atlantic Test transmitting code groups.

copy. To guarantee the authenticity of the logs, Coursey assigned a British observer to listen-in to all Godley's receptions and confirm the signals received.

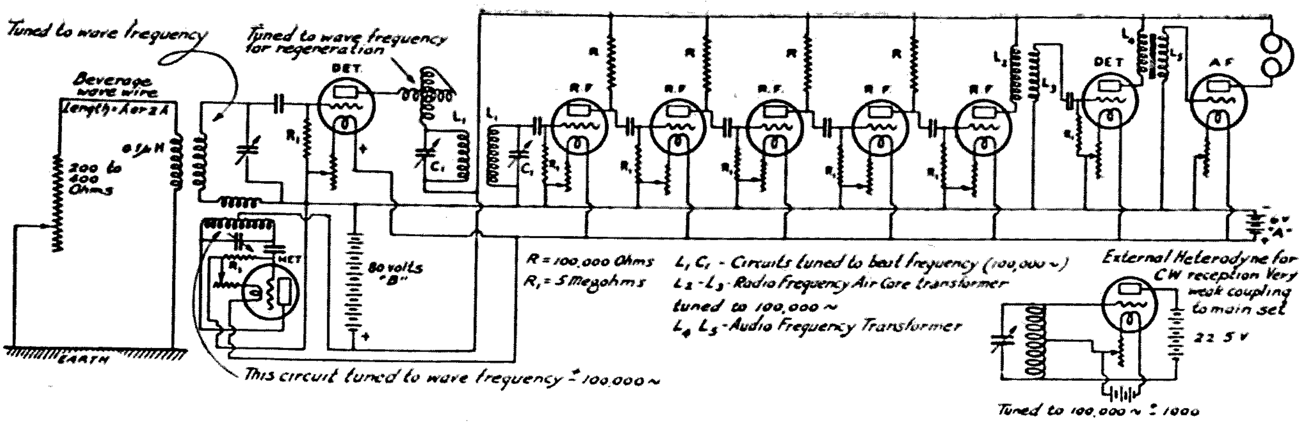
Though commercial interests didn't expect any startling results from the amateurs' Trans-Atlantic attempt, two of them offered free services during the test. MUU, the British Marconi wireless station at Carnarvon, Wales, arranged to transmit the daily results slowly by hand key at 2 am EST each night. Some American hams built long wave receivers to pick up the 14,000-meter signals direct. But for the majority of amateurs unable to receive long waves, WII, the RCA station at New Brunswick, New Jersey, agreed to repeat MUU's report on short waves immediately after its reception.

Godley sails for England

Firmly resolved to "hear signals or bust," Godley sailed for England November 15th aboard the Aquitania. Behind him, with reddened eyes from long watches on the relay routes, American and Canadian hams touched up their rigs for the big assault just three weeks away. Among Godley's luggage nestled two receivers: a regenerative set and a superheterodyne. Both receivers tuned from 150 to 500 meters. Especially built by him for the big job ahead, the superheterodyne—the latest word in advanced receivers—consisted of a 100 kc *if* and detector unit plus an outboard tuner. The tuner, though, worked with either receiver. When placed between the antenna and the regenerative set, it sharpened the performance of that favorite circuit of the American hams. These two receivers represented America's best. Armed with this combination, Godley pitted his ability against the performance of the British hams and their multi-stages of radio frequency amplification.

Shooed from the ship as she made ready to sail, Godley's well-wishers gathered near an opening in the enclosed pier and continued to talk to him via hand-signals in Continental code. Suddenly someone spotted Beverage, the Radio Corporation of America's receiver engineer, standing by the rail on the top deck just a short distance away from Godley. Besides his professional status, Beverage also qualified as a "boiled owl" under the call 2BML. Quickly the gang hand-radioed the news aloft. Godley found Beverage smiling as he walked over and shook hands for Beverage too read the code signals coming up from the pier.

By the time the tugs straightened the Aqui-



The circuit of the superheterodyne receiver used by Godley to receive the short wave signals from America.

tania in mid-stream and her powerful quad screws started her down the Hudson, 2ZE and Beverage sat deeply engrossed in receiver talk and the coming Trans-Atlantic Test. Soon the conversation settled on the "Beverage Wire"—2BML's famed antenna for reducing static on long waves. The technology behind this long-wire antenna appealed to Godley very much, though at the time, he didn't see a need for its merits in the task lying ahead. Fortunately for amateur radio, however, he listened well.

Two days after arriving in England, Godley set up his equipment at Commander Frank Phillips' station in London where he planned to listen for the signals from America. Coursey took care of the operating permit. Like Godley, Phillips too looked back on a long career of radio receiver designing. His Burndept designs compared with the Paragon series fathered by Godley in the United States. The latest, a Burndept III, sat on the operating table waiting to challenge those Godley now unpacked. Godley hooked up the regenerative set first. Before many hours passed, he proved to Phillips the superiority of the regenerative design. Later, when the superheterodyne performed, his English host stared in disbelief. He couldn't believe the little 3-inch coils containing only 10 turns of wire could capture the distant stations pouring from the earphones.

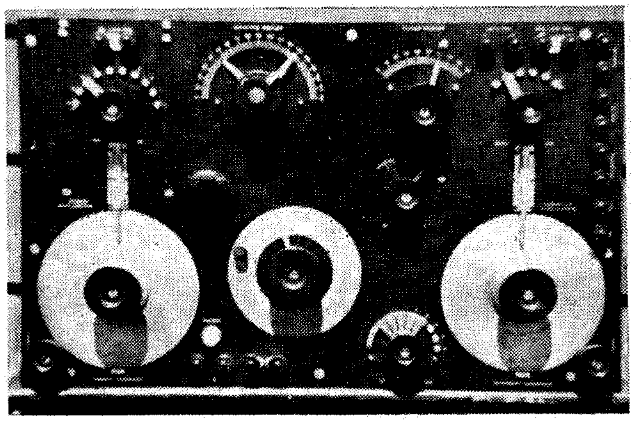
While the contest showed the superiority of the American receivers, it also brought to light the unsuitability of the Wembly Park location. Vast numbers of harmonics filled the ether. The unwanted din emanated from amateur single-circuit tube transmitters in the area and the high-power, Poulson commercial arcs. Also, peculiar atmospherics existed. In America during winter months, atmospherics mostly disappeared around 200 meters. Not so in England. In that land of high tides and lengthy winter nights, Godley noticed the QRN suddenly increase during short periods, then abruptly decrease only to soon reappear in another quarter in a different form. Now he understood the handicaps that plagued British amateurs during the first Trans-Atlantic Test. As a result, Godley decided to leave London and the pea-soup fog, and use a Beverage Wire in place of the planned vertical. He picked Ardrossan for the new receiver site—a small fishing village near Glasgow on Scotland's west coast.

Trans-Atlantic Test No. 2

Breathing heavily with anticipation, Godley huddled over his superheterodyne straining to hear the 200-meter signals from America. He no longer remembered the chilling fog that welcomed him to Glasgow nor the wind-driven rain that greeted his arrival in Ardrossan. Buried too lay the memory of his hectic scurry a week before test-time when only his own initiative plus a little luck persuaded the Assistant Secretary of the Post Office to change the receiving permit from London to Ardrossan. He even forgot for the moment his keen disappointment when an inspection showed the preferred beach sites picked from a map completely covered by water at high tide.

Harmonics from European sparks and powerful CW stations flocked to the Beverage Wire like chickens to a roost. From 1 until 1:30 am GMT, Godley heard nothing else. Apparently he missed no amateur signals by rechecking the received installation again and joining the contest one hour late. But the directional characteristics of the 1300 foot aerial prevailed. Except for a strong signal out of Ireland, he found the spurious signals much weaker at Ardrossan than in London.

Godley slowly tuned across the band hunting for those distinctive tones that set amateur signals apart from all others. Outside, rain still driven by gusty wind beat against the tent. At 1:33 his heart skipped a beat. A 60 cycle synchronous spark on 270 meters finished chewing the rag and signed off with a CUL. A burst of



Navy model SE-95A long wave receiver. This set, made at the Washington Navy Yard in 1917, operated from 1000 to 10,000 meters. Loading coils extended the range to 20,000 meters. The American Radio Relay League used it to copy Paul Godley's messages direct from MUU during the ARRL Trans-Atlantic Test of 1921. Courtesy of W2ZI Historical Museum.

QRN hid the call. But Godley knew he heard an amateur. The thrill made him forget his heavy chest cold and wet clothes, and the miserable weather so aptly predicted by his London friends. He suggested hot coffee and Pearson volunteered to brew it. Midway in the preparation, Godley's sudden shout caught Pearson with both hands full. The spark signal now at double strength boomed through the static as the amateur called an eighth district station and signed 1AAW clearly at 1:42 am. Pearson jumped to his earphones to verify the reception. He got them on in time to hear the "AW". *Not enough to count the call!*

Teased by so near a success during the first half-hour they listened, Godley and Pearson camped on the 270-meter wavelength and waited. The roar of static mingled with harmonics pounded their ears. Suddenly they heard 1AAW again! They recognized the murmuring tone deep down in the atmospherics. Would he break through once more and win his rightful place as the first amateur signal to cross the Atlantic on schedule? Eagerly they held to the faint note and waited. Finally, disappointment crept across their faces: the signal gradually ebbed and disappeared. Spanning 3000 miles once more represented too great a task for the "spark" to repeat. During the remainder of the Trans-Atlantic Test, 1AAW never again became readable copy.

The next night Godley heard nothing. Apparently typical American DX-weather meant nothing in Scotland. The all night vigil beneath a half moon and starry skies got him nothing but a cold deeper down in his chest. Rather depressed, he entered the third night of the test. Outside, boisterous wet weather set in again. Godley wondered if the gusty wind would send the tent flying through the air like it did the first day right after they raised it. But at 12:50 am he forgot all his ills: a switch to CW brought in 1BCG. Bending over the operating table of boards supported by trestles, he no longer felt the hard box beneath him or the unpliable apparatus chest at his back. The feeble light shed by the lone lantern now lost itself upon his concentration. And cold drafts swirled about unnoticed as the little oil stove by his knees fought its losing battle to heat the 12 x 18 foot tent.

The strength of the Yankee signal amazed Pearson. It sounded so commercial he couldn't believe no more than a kilowatt backed the wallop. While Godley utilized the resonance of the telephones to peak the signal, Pearson sloshed to the far end of the Beverage Wire and adjusted the resistor connected between the antenna and the buried ground plates four and a half feet deep. Background static dropped and readability improved. Back in the tent, the two men's enthusiasm knew no bounds as they listened to the loud, steady tone of the first confirmed ham signal to get across. Jubilantly Godley wired Coursey the good news, and sent a cable to E. H. Armstrong at 1BCG requesting him to send a message. No other amateurs got through that joyous night.

Stimulated by the success of the previous night, Godley came on duty the fourth night eagerly anticipating a message from America. At 1 am GMT, 1BCG broke through strong and clear sending "Mges" over and over. Godley waited but no message ever came. Because the British operator used the English abbreviation for the word "message" instead of the American Msgs, Godley's cable arrived at 1BCG reading, "SEND MGES." So, they did. They repeated the letters M-G-E-S over and over all night long.

Godley's disappointment, however, didn't last long. An atmospheric change at 4 am lowered the invisible barrier between America and Scotland letting ham signals pour across the Atlantic the remainder of that night and half of the next. As fast as Pearson verified one call, Godley logged another. One moment they copied a spark buzz; the next, a CW shriek. Power mattered little. Thanks to the excellent characteristics of the Beverage Wire, even two 35-watt stations got through.

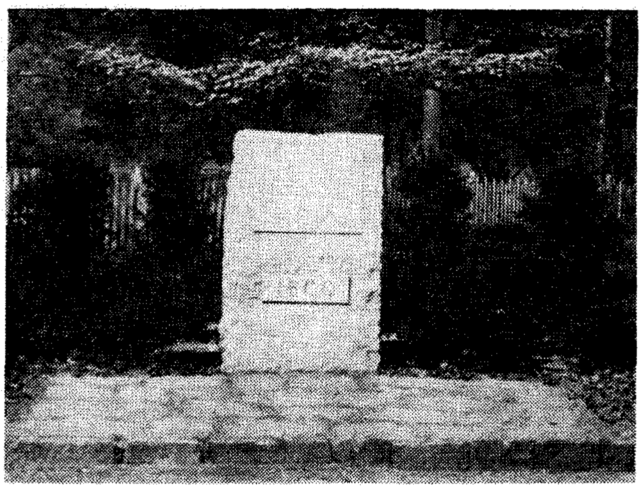
Back in the "States" tension and excitement reigned too. Each night in the Traffic Manager's room at ARRL headquarters, a small group of officials blinked through a haze of tobacco smoke and marveled at the clockwork precision of the hams. One moment 2's filled the air; the next, 3's. Then with an enthusias-

tic, "Go ahead 4's. Give her the juice," the last 3 passed the free-for-all on to the next district. At the conclusion of the second segment of the test, during which time the special stations sent their assigned code groups on slightly longer wavelenths, the officials shifted to long waves and waited for MUU to send Godley's message. If the word check read 17, they learned to expect only weather conditions. But the night the message started "CK 94," they trembled with expectation. Slowly by hand key came the news they wanted: "Heard 1RU BPUSC, 2FP HUZXJ, 2BML FSXVG, also spark 1ARY, LBDT, 2BK, 2DN, 3BP; undamped, 1ARY, 1BCG, 1BDT, 1BGF, 1BKA, 1RZ, 1YK, 1XM, 2ARY, 2AJW, 2FD, 2EH, 3FB, 8ACF, 8XV . . ."

Back at Ardrossan, Scotland, the fifth night began where the fourth left off. In the midst of the scramble to copy as many signals as possible, Godley heard 1BCG break through. He listened a few moments then his pencil fairly flew across the paper. Watching, Pearson saw him write, "Nr 1 de 1BCG." Then came the rest of the *first amateur message to cross the Atlantic:* ". . . words 12, New York. Date December 11, 1921, to Paul Godley, Ardrossan, Scotland. Hearty congratulations. (signed) Burghard, Inman, Grinan, Armstrong, Amy, Cronkite." The message just did get across. It started at 2:52 and ended at 3 am GMT. Ten minutes later, all readable amateur signals ended too. And not another ham call reached Godley during the remainder of the Trans-Atlantic Test.

Call	Location	Type
3BP	Newmarket, Ontario	Spark
1ARY	Burlington, Vermont	"
1BDT	Atlantic, Massachusetts	"
2BK	Yonkers, New York	"
2DN	Yonkers, New York	"
3FB	Atlantic City, New Jersey	"
9ZJ	Indianapolis, Indiana	"
8BU	Cleveland, Ohio	"
1RU	West Hartford, Connecticut	CW
1RZ	Ridgefield, Connecticut	"
1ARY	Burlington, Vermont	"
1BCG	Greenwich, Connecticut	"
1BDT	Atlantic, Massachusetts	"
1BGF	Hartford, Connecticut	"
1BKA	Glenbrook, Connecticut	"
1XM	Cambridge, Massachusetts	"
1YK	Worcester, Massachusetts	"
2EL	Freeport, New York	(?)
2EH	Riverhead, Long Island, New York	CW
2FD	New York City, New York	"
2FP	Brooklyn, New York	"
2ARY	Brooklyn, New York	"
2AJW	Babylon, Long Island, New York	"
2BML	Riverhead, Long Island, New York	"
3DH	Princeton, New Jersey	"
8ACF	Washington, Pennsylvania	"
8XV	Pittsburgh, Pennsylvania	"

The amateur stations heard by Paul F. Godley and confirmed by D. E. Pearson the official observer during the December 1921 Trans-Atlantic Test.

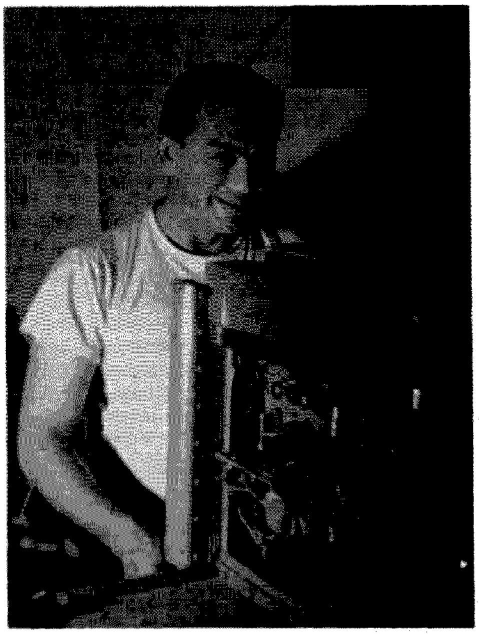


The 1BCG memorial located 200 feet east of the original station site at Greenwich, Conn. It reads: "Near this spot on December 11, 1921, radio station 1BCG sent to Ardrossan, Scotland, the first message ever to span the Atlantic on short waves. 1BCG, an amateur station, was built and operated by members of the Radio Club of America." Courtesy of the Radio Club of A.

To make connections with the Olympic sailing on December 21st, Godley left Ardrossan Friday afternoon for London foregoing the final night of the test. How lucky for him! That night a hurricane whirling across the Atlantic during the Trans-Atlantic Test struck Scotland. Winds greater than Godley experienced at any time backed up the waters of the English Channel until they stood two feet deep in the streets of Hull. Earlier, the Olympic tangled with the hurricane in mid-Atlantic. When she finally reached the safety of her Southampton berth, she displayed battle damage amounting to thousands of dollars and reported two men dead.

After a hero's welcome for Godley in New York City, the ARRL brought him up-to-date with highlights of the test at home. The most interesting one concerned 1AAW. Upon learning that Godley heard 1AAW the first night, the ARRL set out to break the good news to the operator. They found him in nearby Roxbury. Also, they found a transmitter that last saw action six months before. What did it mean? Did Godley hear wrong? After all, Pearson failed to get the earphones on quickly enough to verify the signal. No. Godley heard correctly. Numerous amateurs around Boston confirmed the activity of the call and placed it somewhere in their vicinity. However, no amount of effort could flush the operator out. He preferred *not* to claim the distinction for sending the first Trans-Atlantic Test signal "across" rather than go to jail. A just "reward" for an unjust deed. *The operator who signed 1-A-A-W that night bootlegged the call!*

. . . W2AAA



Robert Walker W8VCO
1849 Meadowlark
Toledo, Ohio

An Audio-TV Transmitter

There's been a lot of controversy over television transmitting and receiving equipment. The problem of transmitting both audio and video has been a sticker. Many methods have been used: a separate transmitter for each, which is rather expensive; a subcarrier 4.5 mc away from the audio, difficult to adjust and design for satisfactory results; etc. I looked around a bit and decided to try the method shown in this article. It works very well, though you may want to modify it some for your own use.

Fig. 1, the block diagram, illustrates the system. Basically it is an FM audio transmitter with the final modulated for video AM. The video modulator was described in the August 1963 issue of 73. It is connected directly to the control grid of the final amplifier. The two meter FM exciter is fairly conventional. The screen of the crystal oscillator is modulated, which produces enough change in frequency for FM. You could use a surplus FM transmitter for this portion. The tripler to 432 mc uses a surplus assembly from the ARC-12. You might also use a surplus 450 mc FM exciter to replace two meter exciter and tripler. The final amplifier is a 4X150A in a coaxial cavity. You may find that this is the most interesting part of the transmitter if you're not in ATV.

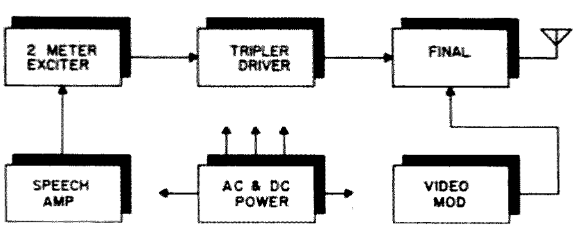


Fig. 1. Block diagram of the ATV-audio transmitter.

Exciter

Fig. 2 is the circuit of the two meter exciter. It has an output of 6 watts. Any transmitter that can deliver 5 to 10 watts of two meter FM can be used. The oscillator is a 6BA6 colpitts. The screen is bypassed for RF, but not for audio. C4 and R15 is the de-emphasis network. Adjusting R15 will affect the bandwidth. Note that C4 and R15 are shown in both **Figs. 2** and **5** as you can put them in either chassis. Initial adjustment was with a grid dip meter. Final tune-up used a power output meter.

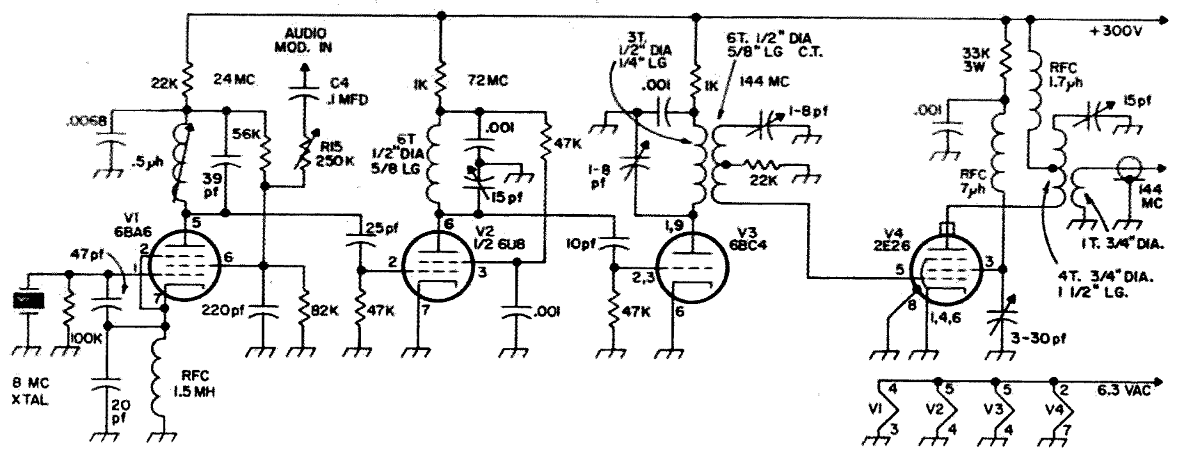


Fig. 2. Two meter FM exciter.

Tripler-Driver

The grounded grid tripler to 432 mc and the grounded grid driver shown in **Fig. 3** use surplus cavities from the ARC-12. These cavities, which use 2C39's, originally operated from 200 to 390 mc, but can operate on 432 with little work. The cavities are about 2½ in. square by 5 in. long. Drive is to the cathodes. Output is from coupling loops in the plate circuits.

First thing to do in modifying these units is to remove the variable capacitors which were mounted externally. Also remove the brackets and hardware for these capacitors and shaft mounts. In the middle of the grid cavities are capacitors which should be removed. The first cavity input circuit is tuned to 144 mc with a three turn half finch coil of thin copper tubing. Adjust C3 for minimum SWR. The second cathode is fed through a short length of coax. On both of the coils the tubing ends at the 2C39 cathodes and heater contacts. Use separate filament transformers for each 2C39. At the center of each cavity, add a disc capacitor. These capacitors are 1/16 inch brass 1 inch in diameter. 10/32 screws 2 inches long are attached to the capacitors and 10/32 nuts are soldered to the cavity walls. The 2C39's are held in place with finger stock on the plate end of the mounting brackets. Mylar discs insulate the plate mounting brackets from the cavities. Forced air cooling of the 2C39's is necessary.

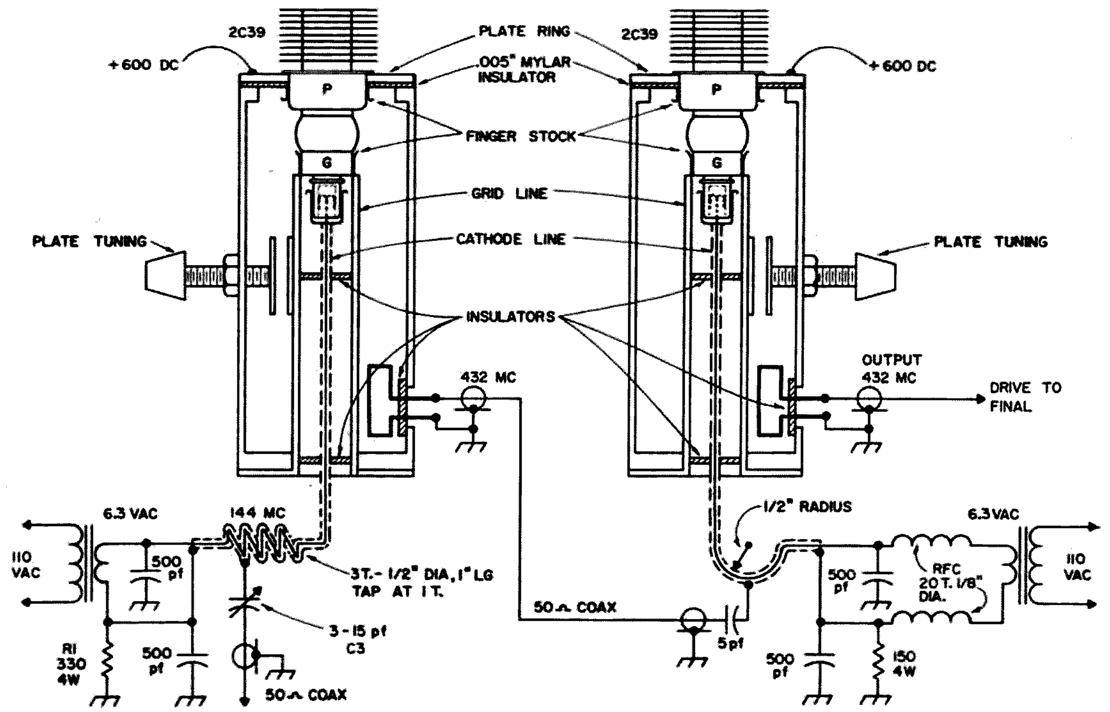


Fig. 3. Tripler and driver using ARC-12 cavities.

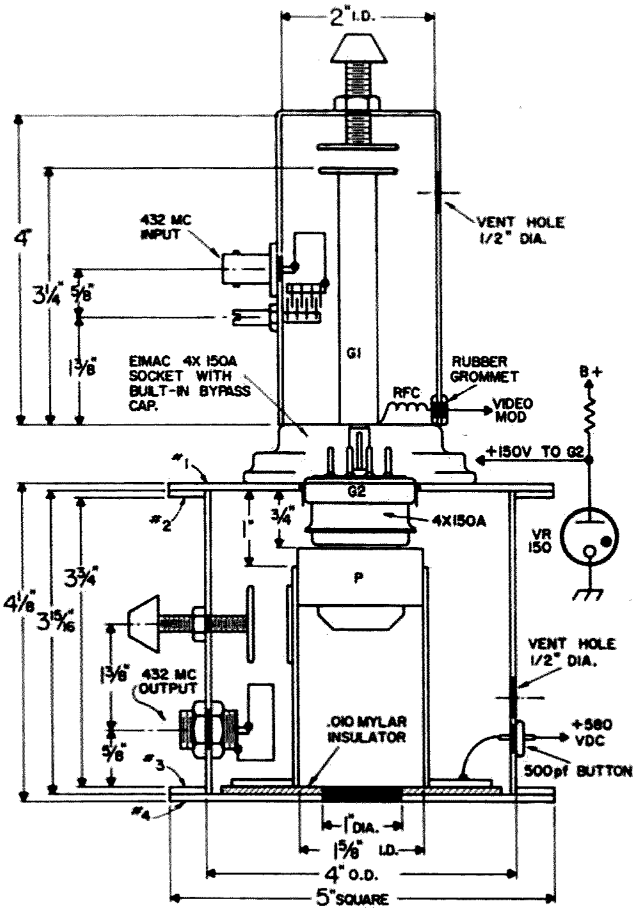


Fig. 4. 4X150A 432 mc final amplifier.

4X150A Final

The 4X150A final is shown in **Fig. 4.** RF input is to the half wave grid cavity through a loop with a series matching capacitor. The ⅜ inch grid line is fastened to the Eimac 4X150A socket grid terminal by a 6/32 headless screw. Video modulation is applied to the grid through a UHF RF choke. The tuning capacitors are 1¼ in discs.

The plate tank is a quarter wave coaxial cavity. The plate of the tube is held in place by the slotted undersize plate line. A mylar spacer insulates the plate post from the cavity wall. Both grid and plate cavities are ventilated for forced air cooling which is essential. Air is blown in through the bottom (plate) cavity, passes through the socket and cooling fins, then out through the grid vent holes.

Mounting plate number 1 is secured to mounting plate 2 with 6/32 hardware. Mounting plates 2 and 3 are soldered to the 4 inch diameter cavity wall. Plate 4 is also bolted to plate 3. The tuning capacitors are 1 inch discs. A 500 pf feedthrough capacitor is mounted near the ground end of the cavity and the 580 volts variable plate voltage is fed through it to the plate line. The output link is adjustable and may be rotated for optimum loading and matching.

The screen voltage is 150 volts regulated. The socket has a built-in screen bypass. The cathode pins of the tube are grounded by the socket.

Speech amplifier

The schematic of the speech amplifier is given in **Fig. 5.** It is a fairly ordinary amplifier with clipping and filtering for best results. Extensive shielding was necessary. The output transformer is 2:1 and is loaded with a damping resistor. R4 is the clipping level control and R12 the amplitude (hence deviation) control. The deviation control is adjusted on the air by feeding in audio until sound bars are noticed, then backing off a bit.

Results

Much credit for the 4X150A cavity goes to W8RQI and W8JLQ. We had been using 2C39's for a long time with great success, but the 4X150A's improved the signals very significantly. Incidentally, we used surplus reflectometers for output measurements and SWR checks.

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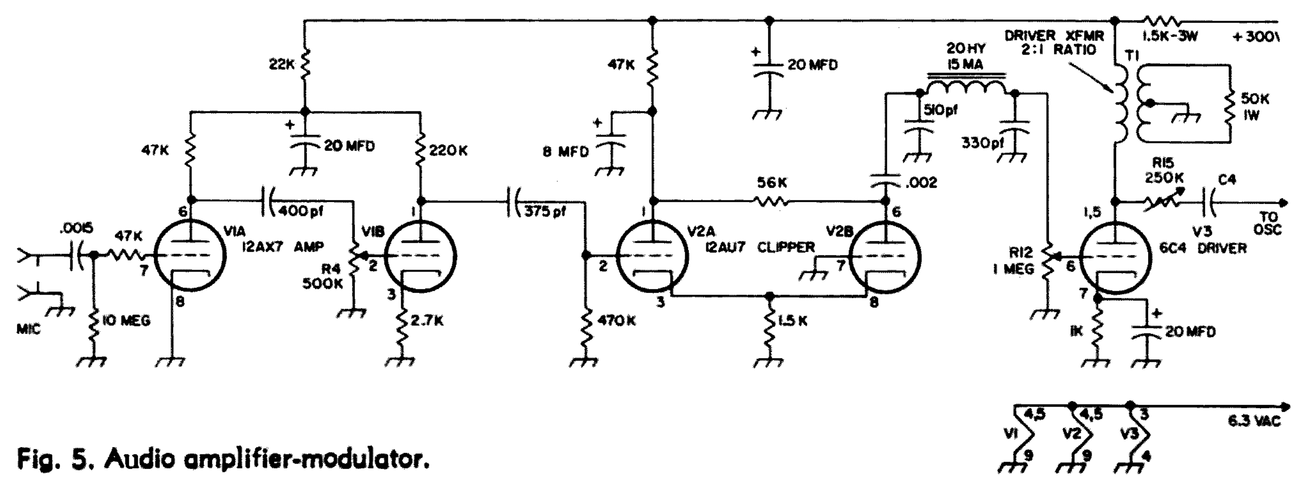

Fig. 5. Audio amplifier-modulator.

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An Inexpensive Hybrid Phone Patch

Commercially built amateur hybrid phone patches cost from $25 to $50. A compromise homemade one can be built from junk-box components, and even if parts are bought new, should not cost over $7.00.

By using a hybrid phone patch there is no need for switching from send to receive position, and when used in conjunction with VOX, makes possible a telephone style conversation. It can be used in the conventional manner with manual switching.

Fig. 1 shows a typical bridge connection. When the bridge is balanced:

$$\frac{Z_1}{Z_2} = \frac{Z_c}{Z_t}$$

Where:

Z_1, Z_2 = any impedance
Z_c = compensating impedance
Z_t = telephone line impedance

Voltages appearing across similarly numbered impedances are:

$$\frac{V_1}{V_2} = \frac{V_c}{V_t}$$

Any voltage V_{in} (receiver output) impressed across Z_1, Z_2 does not appear at T_1 (mike input) since it is connected across points of equal potential. However, part of V_{in} appears across Z_t (telephone line) since it is one leg of the bridge. This condition fulfills feeding receiver output into telephone line and at the same time keeping the signal out of the mike input.

When voltage V_t is developed across Z_t (telephone talks up), part of this voltage appears across T_1 (mike input) and V_{in} (receiver output). The condition is fulfilled for feeding telephone signal into microphone input. Voltage appearing across the receiver output is immaterial because the receiver is inoperative when the microphone is energized.

Z_c is used to approximate the impedance of a telephone line (nominally 500 ohms) and

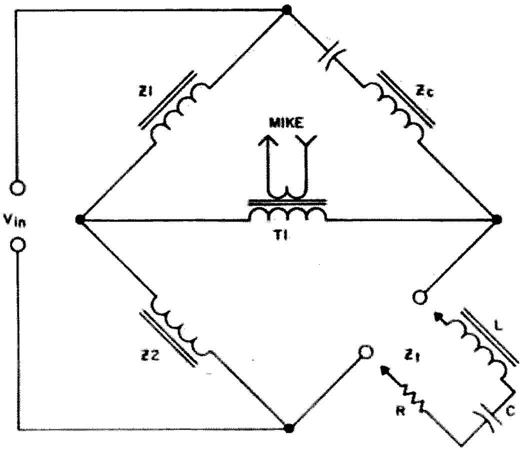

Fig. 1. Typical bridge connection.

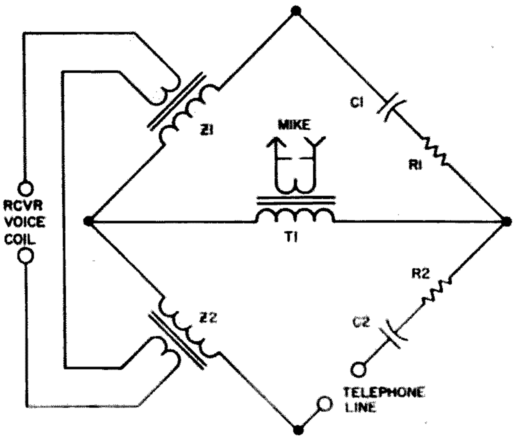

Fig. 2. Evolutionary bridge circuit.

in theory should be compensated for by adjustment of a LCR network.

So far so good, but there are difficulties. For one thing, Z is frequency conscious, and furthermore we are dealing with a complex voice waveform, not a single tone. Resonances occur, line levels vary, telephone line impedances change, resulting in all sorts of voltage and impedance excursions, all of which plays hob with the desired isolation of V_{in} from mike input.

However, a practical circuit embodying the above principles works out surprisingly well and is simple to adjust, requiring only your receiver and a pair of headphones.

An evolutionary diagram is shown in **Fig. 2** and **Fig. 3** shows practical circuitry. Load compensator Z_c degenerates into a variable resistor R_2 which is split into two sections and serves as a simple isolation and matching pad. Considerable loss in audio gain occurs by this arrangement, but we have gain to burn.

Condenser C_2 is to prevent a short across the telephone line to prevent interference with ringing and dialing. Coupling condenser C_2 and compensating condenser C_1 are smaller than the usual value.

Increasing this capacity to get a lower cutoff is not worth the sacrifice in compactness. This small capacity, together with the interposition of R_2, makes for lighter loading of the telephone line, something your phone company will appreciate.

The photo shows components built into a minibox 2" x 3" x 3½", somewhat of a tight squeeze. Receiver output is fed to Z_1 and Z_2 through the voice coil winding of a cheap pushpull replacement output transformer (T_2) which is hooked in series with the station loudspeaker. If more volume in the loudspeaker is desired, the two units can be paralleled, but the series connection was found to be more satisfactory acoustically. It is assumed that the receiver has a built-in muting system, either mechanical or electrical.

The patch is plugged into the mike plug of the transmitter. Don't be alarmed at the idea of using a "low impedance" transformer as a microphone transformer. One hears so much about "proper" transformers to "match the input impedance of the tube." A high impedance transformer is usually used in this position. Transformers which can be used in this application are hard to come by and unless you are willing to pay the price of a "triple shielded Linear Standard" broadcast service unit, you might as well forget the idea.

This quest for gain and quality is what makes necessary, the usual rf chokes, by-pass

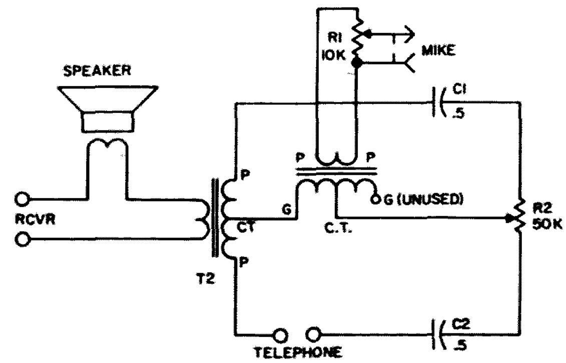

Fig. 3. Circuit of phone patch. T1 is a 1:2 ratio interstage transformer such as Stancor A52C. T2 is an PP plates to VC output transformer such as Stancor A3856.

condensers, shielding and other anti-feedback and hum bucking measures. By using an output transformer or even a power transformer, your feedback and hum troubles are minimized. The gain is reduced and the frequency range is restricted, but we have gain to burn ("O" db line to −55 db mike input), and moreover who ever heard of a high fidelity telephone.

Connection to the telephone line is made by means of two alligator clips in nicks made on the telephone line at two widely separated points (**Fig. 4**). You can even give a quick yank if you want to disconnect the patch in a hurry.

Don't expect a hybrid patch to work like a manual patch wherein you can feed as much audio as you want coming and going. By the way, you will be hearing from the telephone company if you pump too much audio into the line.

As with other hybrid phone patches, this one works best on clean lines with a minimum of hum and a reasonably good signal to noise ratio. Overall voice level is governed by the person on the other end of the line. If he

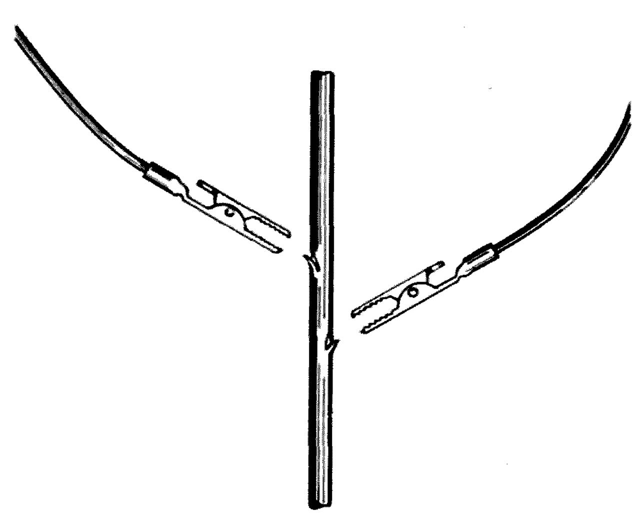

Fig. 4. A method of tapping the phone line without cutting the wires.

talks up loud, you can in turn feedback more receiver output to him and vice versa.

Isolation between receiver output and mike input averages 35 db at 1000 cycles to a maximum of 45 db at 3000 cycles and can be peaked anywhere between 500 and 4000 cycles.

Hook on the telephone line, feed a 1000 cycle tone into T_2 and adjust R_2 for minimum voltage across the mike input as determined by a pair of headphones. If a 1000 cycle tone is unavailable, tune in on a mess of 20 meter AM heterodynes or WWV and adjust for minimum headphone output. Peaking at 1000 cycles is a compromise. Better isolation is had at 2500 cycle peaking but then isolation below 1000 cycles suffers.

Nulling of R_2 is fairly critical but is done only once and holds for a long time unless adjustments are accidentally thrown off. Adjust mike input pot R_1 so that the VOX works when modulating normally. Too much mike gain actuates the VOX continuously and prevents feeding of high level audio from the receiver back into the telephone line.

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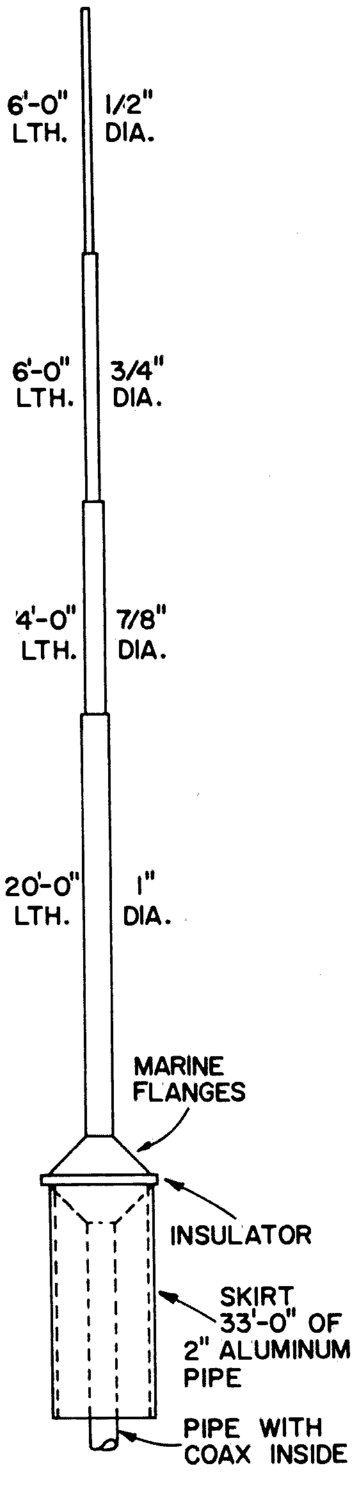

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The Landlord's Delight:

A Coaxial Antenna for Twenty

Some time ago I was forced to QRT because my landlord wouldn't let me install a beam or a half wave dipole on the roof. In desperation I came across the coaxial, or hypodermic, antenna. Many hams aren't too well acquainted with it, but it is basically nothing more than a vertical dipole. It is an excellent antenna for DX because it has a very low angle of radiation and also radiates equally well in all directions.

I immediately decided to figure out the dimensions for a coaxial antenna for twenty meters. I presented these figures to my landlord and I explained to him that this antenna would not take up more than one-half of a cubic foot of space on the roof. To my surprise, he agreed to let me install the antenna. I know that many of you who live in apartment houses are troubled by similar situations.

Matching the antenna is no problem at all for the impedance is close to 50Ω. Close proximity to other objects has little effect on the characteristics of the antenna. Neither has height. The only drawback to this coaxial antenna is that it is a one-band affair. However, you can build two or more for different bands using the formula, total length = 470/frequency, where the length is in feet and the frequency is in megacycles.

With this antenna, you can achieve an excellent match and work out well. So why not try the coaxial?

. . . W2NQS

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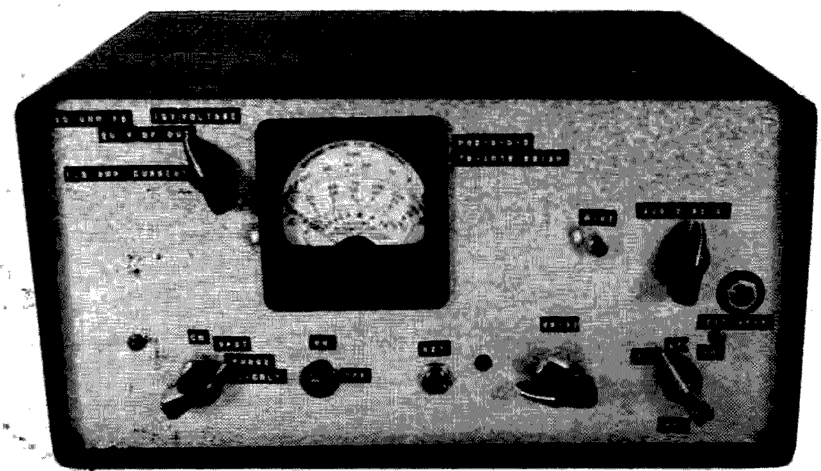


6 Solid Watts on 160

If you would like to be one of the first hams in your area to go on the air with a homebrew transistor transmitter, this rig should appeal to you. It operates on the increasingly popular 160 meter band where TVI is no problem, and the average builder will have no troubles with feedback or neutralization. This rig is economical (a full set of RF transistors and audio transformers costs less than seventeen dollars), easy to build, and features conservative cool running design.

Other advantages of the rig are zero standby current, instant warmup, portability, 30% or more overall efficiency, no need for a high voltage supply, and the added bonus of having a 5 watt portable public address system available.

The signal is only 1½ to 2½ S units down compared to a 50 watt tube type rig on the other fellow's receiver. Good ground-wave coverage is obtained here in the city on phone, and more than once I could sense an upraised eyebrow when I reported the station power as two watts. On CW, Canada and nearby states have been worked with ease.

Circuit description

Four basic units comprise the transmitter. One is the chassis/panel assembly containing switching and metering, and serving as a mount for the three sub-assemblies. One of the subassemblies is the complete audio section, and the other two are RF sections. One of the RF sections is the final RF transistor and its heat sink; the other consists of a Pierce crystal oscillator, the grounded base buffer/driver, and RF final tank circuit components.

The audio section has two amplifiers, a driver, and a push-pull class B final, used either as the modulator, or, in the public address mode, as an audio output stage.

The RF sections all have slug-tuned, fixed frequency coils, since operation is at the one crystal frequency. Over 95% modulation is obtained by modulating the buffer/driver along with the final, rather than the usual method of modulating the final stage only, with its resultant 80 to 85% usual modulation limit. Link coupling is used throughout.

PTT (push to talk) is accomplished by SW2 serving as an on/off, antenna transfer, and receiver muting switch. Mode of operation is determined by SW3 for CW, Phone, Spot, or Public Address operation. Meter versatility is provided by SW1, to measure DC input voltage (0-20v), DC input current (0-1 amp), or RF rms output voltage (0-20v).

The power supply can be any well filtered DC source of 11 to 14 volts at 1 ampere. The author uses surplus four amp/hr Ni-Cad batteries, eleven in series, to provide about 13

volts for up to ten hours of operation before requiring recharging.

The silicon diodes connected back to back across the meter make it almost burnout proof, without appreciably affecting its accuracy.

Construction

Complete the chassis/panel, switching and metering assembly first. It then facilitates construction of the three sub-assemblies as each is built and tested.

The complete audio section is built on a 4" by 8" flat tin plate, and mounted flat on the top of the chassis on the far right, as viewed from the front. Q4 and Q5 are mounted on the same large heat sink, but insulated from it by mica insulators. Q1, Q2 and Q3 do not need heat sinks. All audio components are mounted on this plate except the mike input jack, gain control R8, and the external speaker jack.

The RF final transistor, Q8, is mounted directly on its heat sink without any insulation, and the heat sink itself is insulated from the chassis. This section is mounted vertically in the center on top of the chassis, to the rear. Q8's base, emitter, and collector connections are brought over to the other RF section containing all other RF components.

Next assemble the other RF section on a 4" by 8" plate, and mount vertically along the far left top side of the chassis. Use in line construction, with the oscillator at the front, buffer/driver in the middle, and final tank circuit and decoupling components to the rear. The key jack and RF drive control mount on the front panel. Q6 and Q7 have fin type, press-on heat sinks.

Mounted on the rear of the chassis are the antenna input, output to receiver, output to receiver muting (grounding type), and power supply input jacks.

The photo indicates an on/off switch under the meter, and a center off position on the PTT switch. These were eliminated, as the schematic shows, because with the instant warmup inherent in transistor equipment, the PTT switch receive position becomes the off position. Also, the photo indicates different full

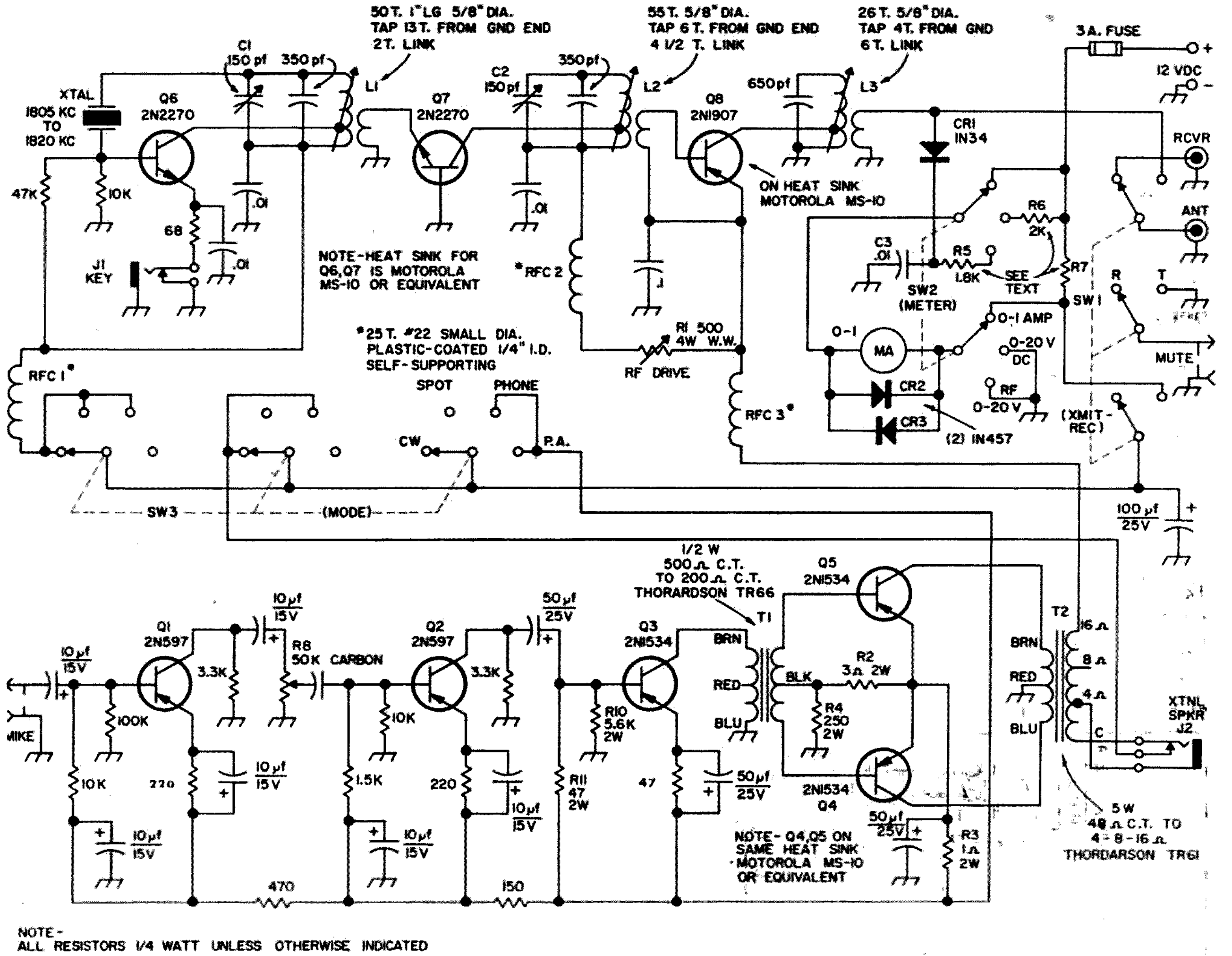
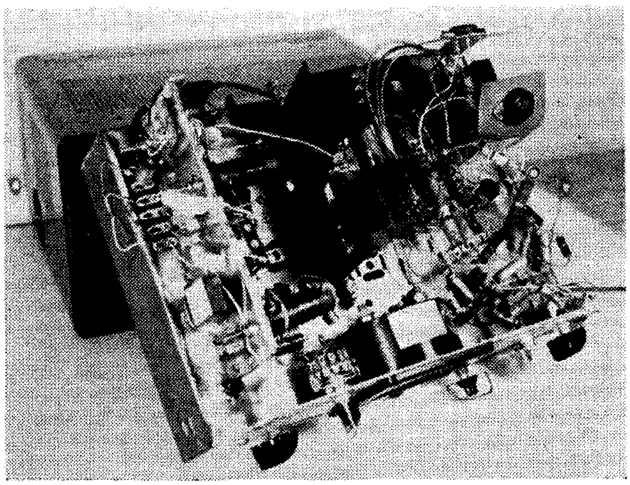


Fig. 1. 6 solid watts on 160 meters.



Neat interior construction is not all-important on 160 meters.

scale meter values, due to the scale markings already on the meter used by the author.

Use sockets for all the transistors, as it helps greatly in testing, substitution, and enables short lead surplus transistors to be used.

Testing and alignment

The meter current shunt R7 is approximately 10 feet of #28 plastic covered copper wire, jumble wound, and adjusted in length until the meter reads full scale with one ampere current flowing through the meter circuit. Next adjust the voltage multiplier R6, until the meter indicates full scale with 20 volts DC applied. Adjusting R5, the RF rms voltage multiplier resistor is a little more complicated. Disconnect the final tank coil link from CR1, shunt C3 temporarily with a 1 µf paper condensor, and apply 6.3 volts from an AC filament source to the input side of CR1. Adjust R5 to give a 6.3 volt reading on the meter. This method gives reasonably accurate RF voltage readings for measuring the transmitter's output.

Test the audio section with a speaker connected to the secondary of the modulation transformer T2. The insulated speaker jack, J2, shoud be carefully checked to be sure it isn't grounded to the chassis; it would then be a direct short for the DC supply. If audio distortion is encountered, adjust biasing resistors R4 and R10 for minimum distortion, with a total idling current of about 75 ma for the entire audio section.

Substitutions may be made to keep down the cost of building, and in fact are recommended for all parts but the three RF transistors and two audio transformers.

Next, get the RF oscillator working. The buffer and RF final will draw no current until driven by the oscillator, as they are biased beyond cutoff without signal input. All three RF coils may be grid-dipped to approximate operating frequency, while wired in, transistors in sockets, and power off. The oscillator coil must be capable of being tuned slightly below crystal frequency, so as to provide the proper inductive reactance necessary for oscillation.

After the oscillator and buffer/driver are operating properly, connect the RF final transistor to its tank circuit and peak all circuits while operating into a dummy load (a 50 ohm 2 watt carbon resistor). Keep the RF output below 4 watts (14 RF rms volts on a 50 ohm line) when on CW, and at 2 watts (10 volts) on phone. If you go above these limits, you risk exceeding the peak collector current ratings of the RF final and early transistor failure, plus non-linearity on phone. At two watts out, the RF stages draw a total of 500 ma. On phone, this rises to 750 ma on audio peaks.

Always check and double check polarities, base, emitter and collector connections, and never operate the audio or RF stages without their proper load.

One requirement of this rig is that it must look into the proper antenna load, which should be a resonant antenna of 50 ohms impedance. The author, whose city lot can't accommodate a full size 160 meter antenna, uses his 40 meter dipole on 160 meters by letting the braid of the coax feeder float, and feeding the center conductor only, from an antenna coupler, which is adjusted with the aid of an SWR meter to the proper 50 ohm impedance. Very good results have been obtained from this antenna configuration, which is probably operating as a shortened vertical with top capacity loading!

The author hopes you will enjoy building and operating this rig as much as he has.

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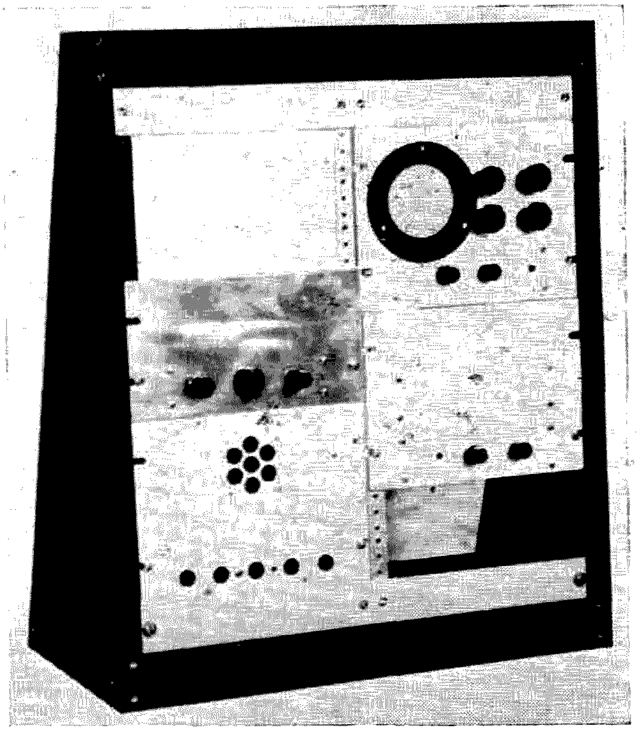

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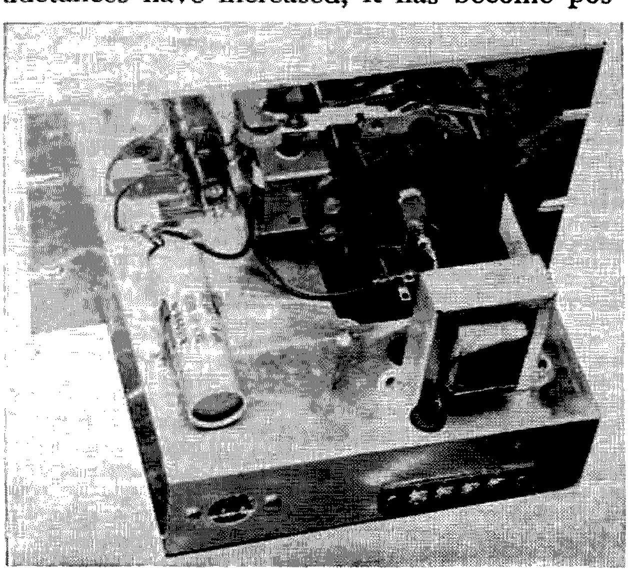
Half Rack Panels

Old-fashioned radio gear, back in the days of the 24A vacuum tube and the great big Majestic receivers, was large and heavy. The standard 19 inch panels, made of heavy steel with generous bracing, were often none too large to carry the load placed on them. There were—and there still are—24 inch panels to be used if the ordinary 19 inch panels cramped the builder's style.

The continuous trend towards small electronics gear is as much a part of electronics as vacuum tubes and transistors. As components have become smaller and tube transconductances have increased, it has become possible to put very impressive amounts of performance in small packages. Since the cabinet manufacturers are extremely conservative, the builder may have real difficulty in finding a suitable small mounting for his circuits.



An Alliance rotator control, remounted for incorporation into a rack.

Also, there are some very considerable advantages to reducing circuits to building-block sections and constructing these blocks to operate relatively independently. Some of these, along with examples of construction are described in Howard Burgess' article in the Feb. 1963 issue of **73**.

But the ambitious builder may find that this approach has certain mechanical and electrical limitations. Among these are 1) the small chassis do not hold enough circuitry, 2) there is no easy way to set up large arrays.

The simple solution to this is to use the relay rack system of construction, but with half-width rack panels. It is not widely known that this is a commercial standard construction. Quarter width is also standard but seems a little narrow for most purposes.

The first photo is a collection of circuits used for a lightning direction locator similar to that just described in **73** and earlier in Scientific American. The various chassis were built over a period of about two years, only one of them being built for this particular project. The scope tube chassis was derived from a radar set, the loudspeaker is one of several on hand, and a Lafayette transistor amplifier with batteries is assembled in back

of one of the 1¾ inch panels. A spare panel finishes off the unused space.

The rack is a standard relay rack with no additional holes. Some aluminum angle stock was cut and drilled to adapt the rack to this style of construction. A 19 inch strip of 1¾ high angle goes across top and bottom, and a pair of ¾ x 1 verticals provides the center support.

All holes are arranged according to the usual rack mounting scheme. This is an irregular spacing, ⅝, ⅝, ½ and repeat. The best way to get this in phase with the holes already in the rack is to transfer a few directly from the rack and then fit in the rest from a steel tape measure. Don't try to do it with dividers, the cumulative error will spoil the work. I drill all the holes but tap only the ones I'm using. A little oil on the tap works wonders.

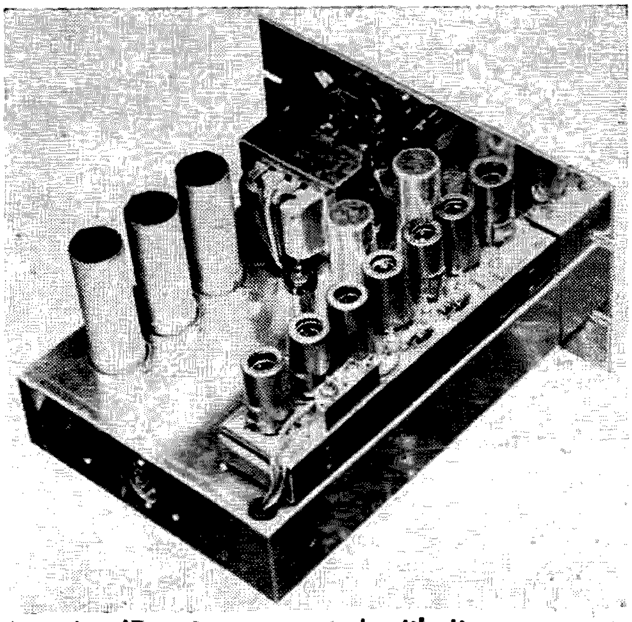
The commercially available half-rack panels are not economical. They cost only a few cents less than full rack panels. One supplier gets $2.46 for an aluminum 7" half-rack panel. This is practical commercially because of the time and tools required to cut down the rack panel, but the amateur builder comes out ahead if he does the job for himself. With care a very acceptable job can be done.

The following tools are required: straightedge, scale, ball point pen, fine tooth saw, center punch, drill with quarter inch bit, and a little oil. The preferred panel is the unpainted masked variety, having a sheet of adhesive paper applied to each side to prevent scratching.

Lay the panel flat on the bench and draw two parallel lines, almost touching, one each side of true center of the panel. The distance between the outside edges of the lines should be the width of the saw cut. Apply the line of oil along the cutting line and go at it. Don't hurry. The oil eases cutting and stops the almuinum from clogging the saw. Having two lines to cut between rather than one to follow, you can do a good job of cutting a straight line. The nice thing to use is a bandsaw, but I get acceptable results from a bench-mounted saber saw.

After completing the cut, each notched end

A Lafayette PK 544 amplifier mounted with batteries, two inputs and two outputs.



A radar IF strip, remounted with its own power and bias supplies.

can be used as a template to mark out the new notches. Punch each notch, drill out to one quarter inch, and cut in from the edge to the hole. Touch up with a moderately fine file and you're done. Requires about five minutes.

The half-rack panels have been used here in various ways. Mounted in a test bench they can serve as outlet and switch holders for heavy filament transformers and regulated power supplies placed out of the way below the bench. If a common supply for all is satisfactory, they are used with a separate large rack or self mounted power supply.

I find that the best way to use the half-rack construction is to build each circuit with its own supply if possible. When the circuit is to be used, there is no problem about matching supplies or connectors; and it is simply a matter of providing input, output, power, and control voltages. A second advantage is the decoupling obtained in this way. With a decoupling filter at the power line, decoupling in the heater and plate supplies, and another such obstacle course in the next piece of gear, a signal passing from one circuit to the next has a mighty rough time of it.

There are enough small instrument transformers available now so that the cost of building several small supplies need not be much of an obstacle—and you can always plan to use one or two large ones.

Most circuits are built on 5¼ inch panels. With a 2 inch chassis height there is just enough room above the chassis for the usual miniature tubes and small transformers. I usually use the 7 inch chassis widths in depths of 5, 7, 9, 11 and very rarely 13 inches.

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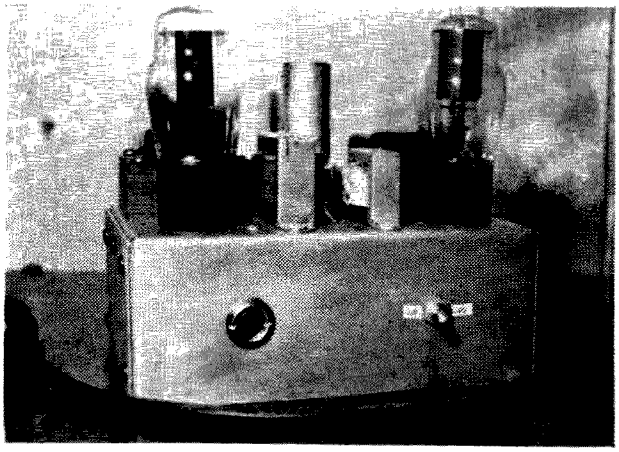


Junk Box Power Supply

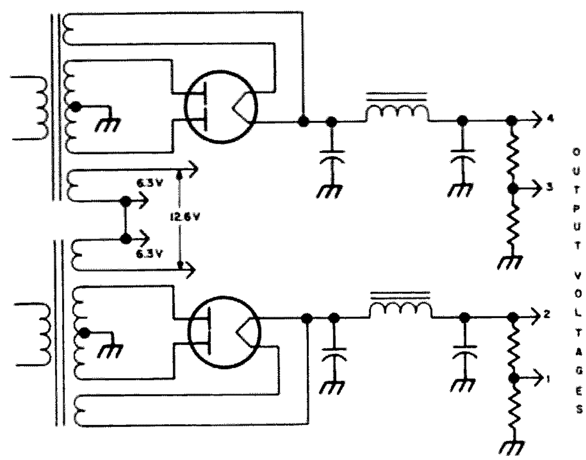
This extremely useful power supply has four dc high voltages and two filament voltages. It was constructed entirely from parts salvaged from two junk radios purchased for one dollar. The only extra part used was the chassis, which was bent up from an old cookie sheet.

The schematic is given as a guide, but the actual wiring and the output voltages obtained will depend on the parts used.

Output connections were made to an octal socket on the rear chassis and a plug was made from the base of a broken tube by soldering wires to the appropriate pins and filling the base with pitch. A spare pin was left available for an extra output voltage to be made up when required.

When picking up an old receiver for parts, of course, make sure it does have a power transformer. The ac-dc sets have a minimum of usable parts. Do not overlook the very old TRF sets, however. Although most of the parts will be unusable, some of the larger sets were rated as high as 130 watts, and have power supply components capable of powering a small transmitter.

. . . Pickles



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A Novel ALC Circuit

As used in the NCX-3

This simple method of ALC is very easy to add to most transceivers. It increases talk power without introducing splatter, as Jim Kyle pointed out in the article in the January 73. I strongly recommend that you read this article if you want to understand what happens in a transmitter when you use ALC.

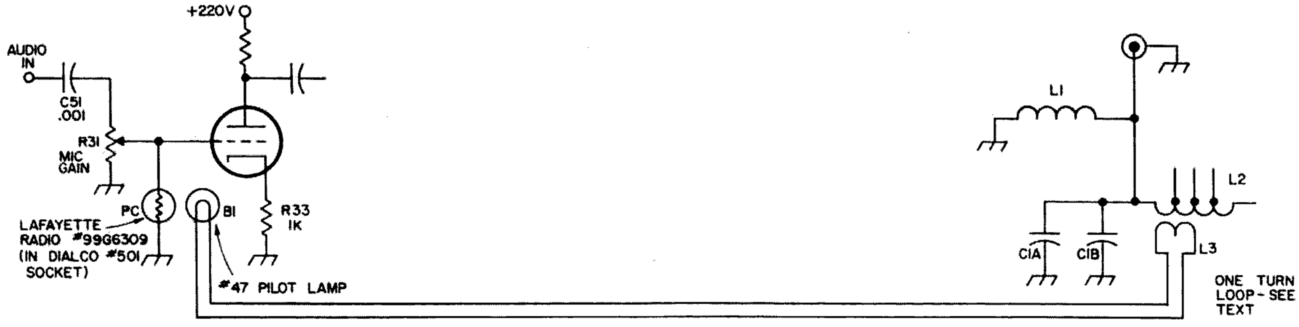
Basically what is needed is some means of obtaining sampling information that tells when the final amplifier is about to be overdriven into the non-linear region of power output where flat-topping, splatter, and distortion result. This information is applied as a correction control signal. Present methods use rectification of some of the rf output power, filtering it and applying it as a bias to control the driver stages, or using the grid current that the final tube draws when it is being overdriven, for this control bias. These systems require filtering, delay, and isolation.

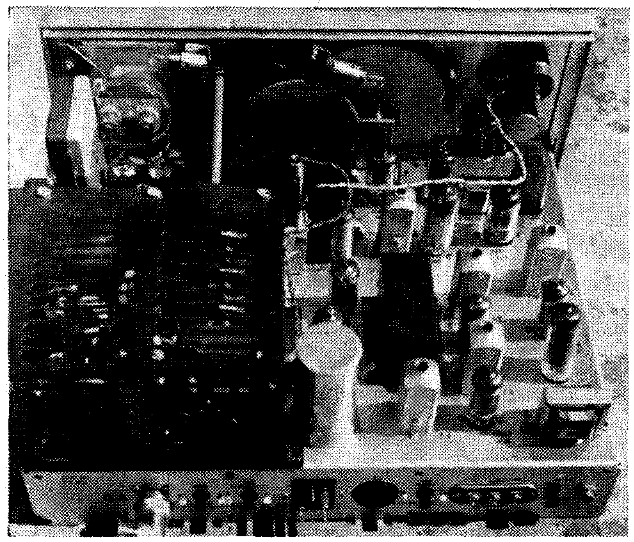
Like most hams who use purchased equipment and hate to mutilate the unit, the following system was developed and found to give very good results from all reports obtained on the air. It avoids rewiring or removal of any of the original transmitter components. The reasoning and operation of the unit is as follows; the sampling signal is easily and economically obtained with a one turn loop and pilot lamp. The brilliance of the lamp varies with the output power of the transmitter and can be regulated for brightness on peaks by adjusting the coupling to the final tank coil. This peak power light signal is directed on a photoconductive cell which in turn is connected to control the audio output going to the driver stage*. The resistance of the photocell varies inversely with the amount of light striking its surface—as the amount of light increases the resistance decreases. By connecting this photocell across the mike gain control, between the swinger and ground, the audio output will automatically be lowered as the transmitter power approaches its peak. In sideband transmitters, the driver output is proportional to the audio input so that control of the audio to the driver in effect controls the output power of the final tubes. In this way a negative feedback is imposed and the overdriving of the final amplifier eliminated.

There are several desirable features built into the lamp-photocell combination that lends itself perfectly to ALC operation. For one, the thermal inertia of the tungsten filament in combination with the 100 millisecond delayed action of the response of the photocell permits the transmitter to approach nearly full power before limiting action occurs. Secondly, as the power to the filament increases, the lamp brightness rises very rapidly, so that the peaks are clipped in a rounded manner rather than being clipped off sharply so they cause spurious signals. The thermal action in the reverse direction avoids the 'pumping effect' in the audio when the delay action is of short duration.

*See the March '65 73, page 36, for a similar application of a pilot lamp and photocell.

Fig. 1. Schematic of the simple ALC adapter.





The simple ALC circuit applied to the NCX-3

Construction

From the photo it can be seen that construction and installation of the ALC unit is extremely simple. The parts consist of a #47 pilot lamp, and four foot length of hook-up wire, an inexpensive photoconductive cell, and a clamp type support for the photocell.

Carefully remove the transmitter from its cabinet then remove the tank coil shield by taking out the self-tapping screws exposing the tank coil on its ceramic form. Fold a two foot length of hook-up wire in half and twist together. Snake the looped end of the wire through the small hole on the top of the ceramic form and open out the wire to form a one turn loop within the tank coil. Pass the twisted portion of the loop between the slits of the tank shield and replace the shield. Secure the balance of the wire along the shield can with lacing cord and tie in place.

Twist another two foot piece of hook-up wire together and solder the ends respectively to the mike gain control swinger and ground. Slip the clamp type photocell socket on the switch support plate and solder the other ends of the twisted wires to the lugs. Secure the pilot light to the photocell with a piece of plastic electrical tape so that the filament shines directly on the active cell surface. Screw the lamp-photocell combination into the socket and solder the twisted wires coming from the pick-up loop to the pilot lamp. The ALC control is now complete and ready for operation.

Tune-up

Rest the transmitter on an insulating surface such as a magazine and connect it up for operation. BE CAREFUL—LETHAL VOLTAGE. As a precaution to prevent burning out the lamp, turn the one turn loop with a thin insulating rod so that a minimum of coupling is in effect. Tune up the transmitter in the normal manner, then adjust the coupling of the loop using the insulated rod so that the lamp burns at about half brilliance. This is all the brightness you will need and represents the maximum power output from the final. Turn the selector to SSB and talk. Adjust the kick of the milliammeter to about an average level of 175 to 200 ma. Check with the boys of the air as to your quality and splatter, you will be agreeably surprised at the reports. There is one thing I haven't been able to work out satisfactorily yet, however, that is the change in the brilliance of the lamp in changing from band to band. If the lamp is too bright you will not be able to get enough audio output to drive the rig to full output.

This method is applicable to any rig that does not now have ALC. On the air reports and operation have proved that even though the ALC is a simple and inexpensive unit the results have been of great quality.

. . . W2KAK

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The Nuvistatector

Many fine receivers can be found on the used shelves today in most of the radio distributors throughout the country. The biggest problem in these older receivers is the fact that nothing of a product detector can be found. When some of the older receivers were built, SSB was not even thought of!

Most of these older receivers are stable enough but lack that ability to tune the single sideband stations in without too much trouble. With this simple and easy to build product detector using three small Nuvistors, one can build it and tuck the entire package under the power transformer, or in a small space on top of the chassis.

The first problem that confronts the builder is the fact that you will have to chop a hole in the front panel of your 75A2 or your Super Duper Pro and there goes the resale value along with the looks of the equipment. This problem has been taken care of with ease by the use of the plate sensitive relay, K1, which is wired in series with the original bfo. By replacing the original plate resistor of the bfo with the 10,000 ohm relay and a series resistor, a perfect switch for switching the audio from the product detector to the original am detector has been achieved. When the bfo is turned on in the normal manner, the operator will be switching his am receiver over to a ssb receiver and the equipment has not taken on any odd switches hanging off in mid air or through the front panel.

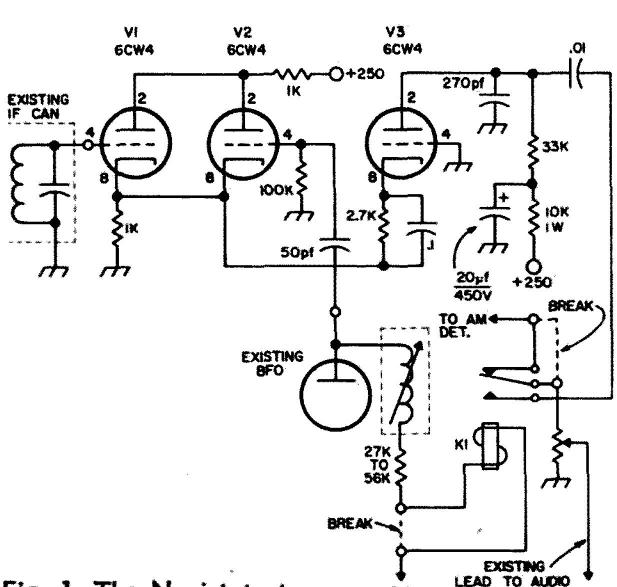


Fig. 1. The Nuvistatector.

The product detector is built on a piece of fiber glass epoxy board 6" x 1" and the sockets are spaced 1" center to center. The relay, K1, is mounted on the extreme end next to V3.

Connection to your receiver is very easy and simple. First, check to see if you have a tapped secondary on the last *if* can. If so, it will be noted that this feeds the grid of the am detector. This is the point where C2 connects through the relay, of course. Leave both the am and the product detector connected to the *if* can. This will not interact or cause any trouble.

Next check and see where the grid of the audio is connected. Most receivers will have a noise limiter preceding the af stage so the grid of the limiter will be the point where the relay should be connected. The arm of the relay is connected to the grid of the audio. When the bfo is on, energizing the relay, it will be connected on the bottom contact where C2 is attached. The top contact will be fed to the grid of the audio section, or the noise limiter, if you have one. It is best to use the grid of the limiter as this will allow you to be able to use it in the ssb mode.

None of the circuits are tuned so nothing has to be bothered with so when this project is finished being installed, it is ready to use. It should be noted that the detector is not only good for ssb reception, but it is excellent for cw and rtty, also. Since the usual diode detector has many distortion products and has to be used with the rf gain turned down, the audio turned up, signals don't actually have a chance to be heard in your regular receiver. With the addition of this product detector (so named since the output equals the product of the input signals and the bfo signal) the rf gain can be used at full position, therefore allowing the audio to operate correctly which allows you to have distortion-free reception with even the smallest of signal from the front end, as well as the fellow that lives down the street who runs a good gallon on the same frequency! . . . K9EID

Jim Fisk WA6BSO

Transistors for Hams

With more than 4,000 types of transistors on the market, it becomes a little difficult to choose those types suitable for amateur applications. This becomes evident when you consider the types of transistors that appear in amateur oriented construction articles. Many inexpensive, high performance semiconductors presently available are apparently not widely known. This is not to say that the ubiquitous 2N107, 2N274, 2N384 and the like are not good transistors; it is just that there are better types available at the same price. For instance, the 2N2953 may be used in many of the same circuits as the 2N107, but has higher voltage ratings, higher current gain, and a 10 mc cutoff at the same price. The 2N1226 is identical to the 2N274 except for higher voltage ratings. Many other familiar low-cost transistors have similar stories. For this reason, the following list of transistors was compiled as a guide.

This is by no means a complete list. Many manufacturers make transistors that have different type numbers, but are nearly identical electrically. Furthermore, in some cases identical transistors have different type numbers (and prices) because of the package. For instance, the 2N1526 and 2N1527 are electrically identical, but the former is in a JEDEC TO-1 can, the latter in a TO-40 package.

In looking through this list you will no doubt notice the absence of many familiar faces. There are several reasons for this. First, this list was prepared to familiarize you with some of the later transistor types and it is assumed that most amateurs are familiar with the older popular ones. The time has come when many of the older types are "not recommended for new design". For this reason this list is limited for the most part to those types registered since 1961.

The list is laid out in six main application categories: Audio and General Purpose, Audio Power, RF Amplifiers, RF Mixers, RF Oscillators, and RF Power. Within each category, types are arranged in order of increasing value of a key parameter. For the audio and general purpose types, the key parameter is current gain; audio power types, power dissipation and rf types, frequency.

Although the column heading should be self-explanatory for the most part, a few explanations are in order. The first column gives the transistor type number and the second column whether it is PNP or NPN. The third column lists the maximum voltage between collector and emitter (V_{ce}) or between collector and base (V_{cb}). V_{cb} is differentiated from V_{ce} by an asterisk. The fifth column gives the forward current gain of the device. A-C current gain (h_{fe}) is differentiated from D-C current gain (h_{FE}) by an asterisk. Where only one number appears in this column, it is a typical value. Two numbers indicate minimum and maximum limits. The collector currents in column six are those currents at which the current gains of column five were measured. The frequencies in the seventh column are designated in three ways. The gain-bandwidth products (f_T) is the most popular parameter and requires no further designation. The high-frequency cutoff in the common base configuration (f_{hfb} or f_a) is designated by an asterisk. The maximum frequency of oscillation (f_{max}) is indicated by a #. The manufacturer and current price are provided in colums eight and nine.

For the discriminating VHF and UHF enthusiast, a short list of low-noise types is also provided. Several of these types are not included in the main tabulation because of their cost.

One of the problems after selecting a particular transistor is in purchasing it! Most local electronics stores carry a limited inventory of semiconductors if any at all. However, only those manufacturers with large distribution facilities are included on this list. If your local distributor should not stock a particular type, any type on this list is available from either Allied or Newark Radio in Chicago. . . . WA6BSO

Type No.	Type	P_c (W)	V_{cb}° V_{ce}	h_{fe}° h_{FE}	I_c	f_{hfb}° f_T	Mfr	Price

Audio and General Purpose Types

2N2430	NPN	.36	32	63°	20 ma	2.5	Amperex	$ .57
2N3414	NPN	.36	25	75-225	2 ma	120	GE	.77
2N2923	NPN	.2	25	115	2 ma	120	GE	.65
2N2614	PNP	.1	20°	160	.1 ma	10	RCA	.50
2N2953	PNP	.12	30	200°	10 ma	10	RCA	.50
2N2429	PNP	.5	32	220°	2 ma	2.3	Amperex	.57
2N3391	NPN	.2	25	250-500	2 ma	120	GE	.72

Audio Power Types

2N2706	PNP	.5	32°	135°	20 ma	17°	Amperex	$ .57
2N3402	NPN	.9	25	75-225	2 ma	120	GE	.91
2N2431	PNP	1.0	32	90	300 ma	1.5	Amperex	.62
2N2148	PNP	12.5	40	100	1 A	3	RCA	1.25
2N2869	PNP	30.0	60°	50-165	1 A	.45	RCA	1.52
2N456A	PNP	150.0	40°	30-90	5 A	.20	TI	1.80

Small Signal VHF and RF Transistors

2N1524	PNP	.12	24°	60	1 ma	33	RCA	$ .40
2N1632	PNP	.08	34°	80	1 ma	45	RCA	.50
2N2672	PNP	.1	32°	150	1 ma	75	Amperex	.67
2N2671	PNP	.1	32°	150°	1 ma	100°	Amperex	.84
2N1180	PNP	.08	30°	80°	1 ma	100	RCA	.68
2N2716	NPN	.2	18	75-225	2 ma	120	GE	1.01
2N1748	PNP	.06	25	50-150°	1 ma	132	Sprague	1.15
2N1177	PNP	.08	30°	100°	1 ma	140°	RCA	.83
2N2207	PNP	.26	70°	200°	1 ma	175°	Amperex	1.42
2N1747	PNP	.06	20	10	1 ma	200°	Sprague	1.05
2N2654	PNP	.1	32°	50	1 ma	250	Amperex	1.42
2N1745	PNP	.06	20	10	2 ma	600	Sprague	1.80
2N3399	PNP	.08	20°	20	1.5 ma	600	Amperex	2.55
2N3478	NPN	.2	15	9	2 ma	900	RCA	2.06
2N1742	PNP	.06	20	10	2 ma	1300#	Sprague	2.93
2N2360	PNP	.06	20°	10	2 ma	1600#	Sprague	2.40
2N2398	PNP	.06	20°	10	2 ma	1600#	Sprague	3.45
2N3294	NPN	.2	20	10	2 ma	2000#	Motorola	1.65

VHF and RF Oscillators

2N1526	PNP	.08	24°	130°	1 ma	33	RCA	$ .43
2N1639	PNP	.12	34	75	1 ma	45	RCA	.53
2N1727	PNP	.06	20°	40	1 ma	100	Sprague	1.00
2N2362	PNP	.06	20°	33	2 ma	1600#	Sprague	2.10
2N3285	PNP	.1	20°	15	3 ma	2000#	Motorola	1.80

VHF and RF Mixer Transistors

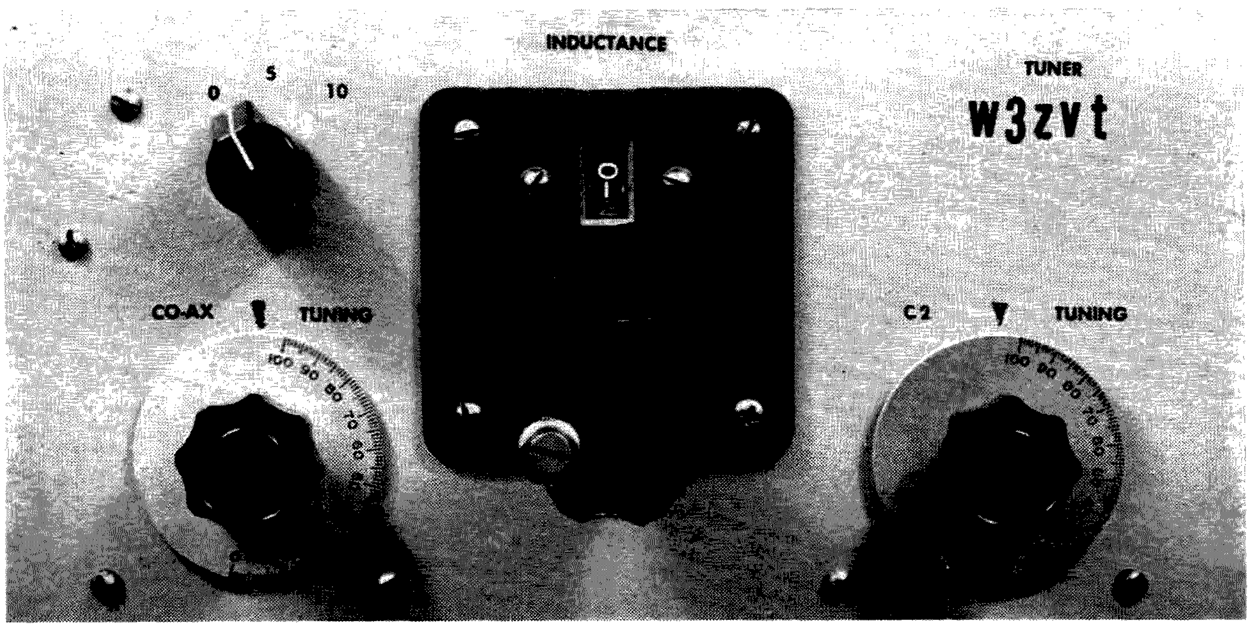
2N1743	PNP	.06	20°	33	2 ma	1300#	Sprague	$ 2.87
2N2361	PNP	.06	20°	33	2 ma	1600°	Sprague	2.25
2N2399	PNP	.06	20°	33	2 ma	1600#	Sprague	2.25
2N3292	NPN	.2	25°	10	2 ma	2000#	Motorola	2.10
2N3284	PNP	.1	25°	30	3 ma	2000#	Motorola	2.02

VHF and RF Power Transistors

2N2270	NPN	5.0	60	50-200	150 ma	60	RCA	$ 1.49
2N697	NPN	2.0	40	40-120	150 ma	100	GE	.93
2N696	NPN	2.0	40	20-60	150 ma	100	GE	.93
2N3298	NPN	1.0	25	60-120	10 ma	150	Motorola	2.30
2N3118	NPN	4.0	60	50-275	25 ma	380	RCA	4.95
2N708	NPN	1.2	20	30-120	10 ma	480	GE	1.17
2N914	NPN	1.2	15	30-120	10 ma	480	GE	1.40
2N3866	NPN	5.0	55	–	–	800	RCA	4.95

Low Noise VHF Transistors

2N2415	NF = 2.4 db at 200 mc	TI	$26.30
2N2865	NF = 3.5 db at 200 mc	TI	6.50
2N2398	NF = 3.6 db at 200 mc	Sprague	3.45
2N2857	NF = 4 db at 450 mc	RCA	24.75
2N3478	NF = 5 db at 470 mc	RCA	2.06



An all-band flexible antenna tuner.

The Flex-Match

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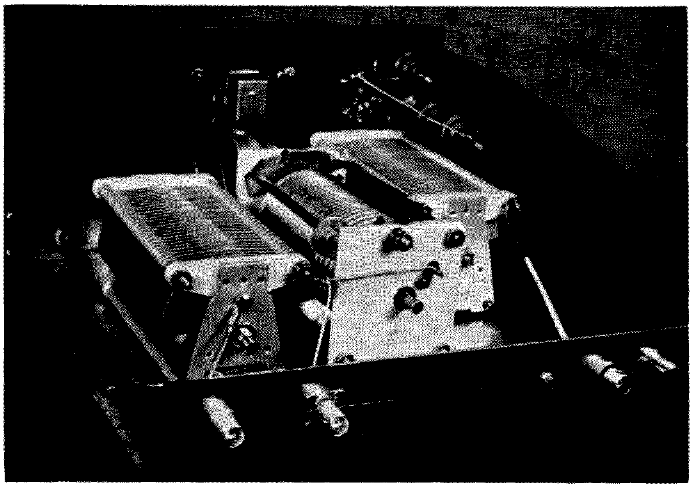
Almost all of the transceivers and transmitters on the market today have fixed output loading in their pi-networks. The value of loading capacitance is calculated for a load of approximately 70 Ohms. This is a good idea, for some wide range pi-networks with variable loading can cause a loss of operating Q when the unit is loaded into an antenna that departs widely from the design center of the network. Fixed loading has its disadvantages though, one of them being the fact that with a high reactive component in the antenna circuitry the transmitter no longer looks into a resistive load. In such case a high SWR results and any



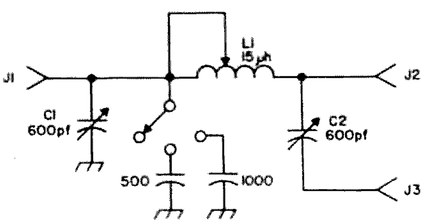


Fig. 1. Schematic of the Flex-Match

Left: Back view of the Flex-Match

impedance mismatch can degrade the linearity of the final; also there is one piece of gear I know of that has a habit of burning out plate chokes in cases of high SWR.

I got tired of fighting high SWR and decided to do something about it. All of my gear has fixed loading, so I decided the best approach was an antenna tuner. I wanted a tuner that would load into Aunt Gertie's girdle stays if need be, and still present a proper load to the transmitter for proper transfer of energy.

My requirements were:

1. A minimum of switched circuitry (lossy you know).
2. Wide flexibility and capability of loading a wide range of antennas.
3. Good resetability so that any band could be set up in a minimum of time.
4. Capable of operation in several configurations.

As can be seen from the schematic, this unit is capable of performing all of these functions with a minimum of switching and/or patching. The circuit consists of C1 and its associated switched capacitors, a variable inductor, and the output capacitor C2.

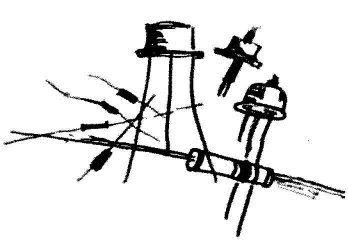
C1 and L1 comprise an L-network when the antenna is connected to J2, for series feed it is connected to J3. Finally, the whole thing can be used as a pi-network if a shorting plug is inserted in J3 and the antenna fed from J2.

The turns counter was scrounged from a BC-610 antenna tuner. In order to isolate C2 from ground, it was epoxied to a ¼ inch piece of plexiglass which in turn was epoxied to the chassis. In the photograph of the unit a pick-up wire can be seen next to J1; this is for a scope probe or CW monitor.

Tune up is relatively simple and follows standard Handbook procedure. Just insert an SWR bridge between the transmitter and tuner and adjust C1 and L1 for minimum reflected power. In cases where two different settings of C1 both give unity SWR, use the one that has minimum capacitance.

One of the configurations, either L-net, Pi-net, or series feed, will give the unity SWR you've always wanted.

. . . W3ZVT



Jim Kyle K5JKX
Jim Speck W5PPE
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Adding ALC to the Swan SW-240

For those Swan owners who would like to increase their average talkpower output a bit, as well as drastically improving their margin of safety against flattopping and other forms of distortion in the 6DQ5, this simple (half-day) modification may be of interest. No visible external changes are involved, although one additional tube is added inside.

The effect of the modification is to make it impossible to drive the 6DQ5 more than some 30 microamperes into the grid-current region, regardless of the position of the mike-gain control. Until grid-current is approached, of course, the higher settings of the mike gain control give louder output; old-time AM men will recognize the similarity to compression and speechclipping.

But while speech clipping is normally considered impractical for SSB use, ALC of the sort we're adding is a most practical thing. The big difference is that our ALC operates *only* when the final is being driven to grid current. The rest of the time, it's effectively not there. While a certain amount of peak clipping must naturally result, extensive and critical on-the-air tests have failed to reveal any trace of buckshot or splatter. These tests were conducted over a range of one mile—surely close enough to show up any garbage if it were present.

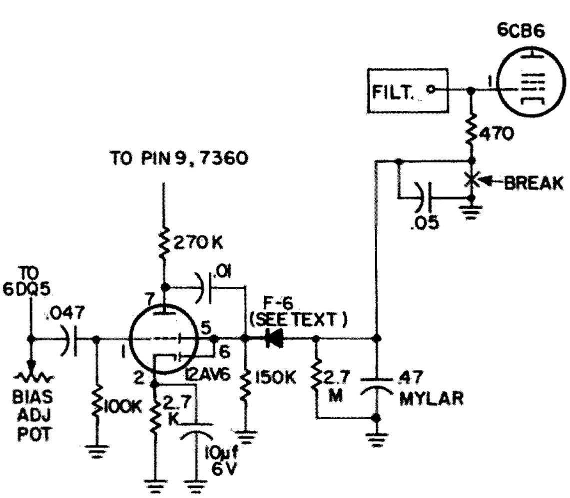


Fig. 1. Added circuitry.

Like any other ALC circuit (with very few exceptions) this one makes use of the fact that a control grid, when drawing grid current, is also a most effective diode detector. As a result, whenever grid current is drawn by signal peaks which recur at audio frequency (as is the case when a SSB linear is flattopping), an af component exists in the grid circuit.

We merely pick off this af component at the bias-adjust potentiometer, amplify it through a high-gain triode, and rectify it to obtain a negative dc control voltage. This control voltage then goes through a "hang" diode to a long-time-constant RC network, which charges up instantly when control voltage is applied but takes more than a second to discharge, once charged. The "hanging" control voltage is then applied to a low-level stage control grid, in this case the 6CB6 *if* amplifier, to reduce the gain of that stage.

The result is little short of fantastic to anyone who hasn't used such a circuit before. In the SW-240, the control is applied to the 6CB6 which is a sharp-cutoff tube. It takes only a few volts of control voltage to kill this tube completely, and when the tube is dead nothing gets through to drive the final. This in turn removes the source of control voltage, allowing the tube to recover.

In operation, the 6CB6 never cuts off. As the final drive passes into the grid-current region, the control voltage appears virtually instantly, reducing 6CB6 gain so that the drive never goes high enough to let the system shut down the rig. The rapid response is due

in no small part to the action of the added 12AV6 amplifier; this stage has a gain of 35, so that only 30 *millivolts* of af hash at the 6DQ5 grid will put a full volt of control bias on the 6CB6. ALC voltage seldom if ever rises above 2 volts; the 6CB6 needs around 8 volts to cut off completely.

We did run into a few fine points of design in putting the circuit to work, which we'll summarize here should you be tempted to make changes (changes may help—we stopped when we had operation which satisfied us completely and made no further attempts to optimize the circuit).

The original hookup applied 215 volts to the 12AV6 amplifier stage from the main power plug. With this, we had some residual control voltage on "receive" which cut down the receiving sensitivity. The next change was to move the 215-volt supply point over to the junction of R1308, a 6K 5-watt resistor, and the keying relay, which has B+ present on transmit only. This took care of the residual voltage, but we found we had big trouble when the function switch was turned to "tune".

In the "tune" position, a fair amount of grid current is deliberately developed in the 6DQ5. The hash present was amplified through the 12AV6, rectified, and applied to the 6CB6, cutting it off. This removed drive from the final until the ALC time-constant let the control line voltage drop below cutoff for the 6CB6, at which point the cycle repeated itself. Or, in other words, we had ourselves a nice relaxation oscillator going.

A search for other voltage sources for the amplifier which would be controlled by the "function" switch so that ALC would be killed while tuning turned up two possibilities. One was the 6DQ5 screen, which goes from +185 on "operate" to +90 on "tune". This didn't work; the oscillation, though weaker, was still present on "tune".

The other possible source, which we ended up using, was the cold-side deflection plate of the 7360, pin 9. This plate is at approximately +20 volts on "operate" and is grounded on "tune". At first we had some worries about using such a low plate voltage for our amplifier, as well as about the effects on the carrier-balancing networks of drawing an additional mil or so through them. Both sets of fears proved groundless. The amplifier still performs its function perfectly (though without quite so much gain as before) and the carrier can still be balanced out quite handily. In fact, we found carrier balance to be even better than before. This we cannot explain, but the left-over carrier at balance is now undetectable on an output meter which reads 100 milliwatts with ease. This is at least 30 db down, and undoubtedly far less than that.

Enough theory. By now you want to know how to do it for your own rig. Start by cutting and bending a small aluminum bracket as shown in Fig. 1. The two holes should be spaced to fit the two screws in the Swan which hold the final tank coil plastic support. Before drilling the tube-socket screw-holes, fit the bracket into approximate position on these screws beneath the chassis so that the tube will be horizontal, parallel to the back apron, and adjacent to the bias-adjust pot. Rotate the socket in its punched hole so that the blank space between pins 1 and 7 points to the back apron of the rig, and mark the position. Then drill the holes and mount the socket in place. Put a 3-terminal (two insulated plus ground) tie point on the socket-mounting bolt away from the rear panel. Wire in the tube connections and the F-6 silicon diode and time-constant network.

All these connections can be made before mounting the bracket in the transceiver. The diode and the R-C network mount on the 3-terminal tie strip. The diode should be specially selected for high back resistance, as read on an ordinary VTVM. Out of a dozen silicon diodes tested at random in this manner, most read about 5 megohm back resistance, a few showed as little as half a megohm, and one read more than 1000 megohms. The F-6 used in our installation measured 500 megohms on this check; this amount or more of back resistance we know will work. Smaller values may be usable but we haven't tried them. (While these readings actually bear no relationship at all to the normal reverse resistance of the diode, they do give a relative indication of the resistances of two or more diodes checked on similar meters. Therefore they are valid for the purpose mentioned here.)

With all connections to the tube socket soldered, and the plate resistor, grid capacitor, and filament leads hanging free, you can install the angle bracket in the rig. Run the filament leads direct to the power plug. Connect the free end of the grid capacitor to the arm of the bias-adjust potentiometer. Insulate the free end of the plate resistor, attach a length of hookup wire, and connect to pin 9 of the 7360, following existing cable runs to avoid introducing stray capacitance around the filter.

At this point, you can fire everything up, rebalance carrier, and check to see if you get

proper ALC voltage. Use a dummy load at this stage, for the output of the rig will be pretty horrible until we close the ALC loop. With mike gain open wide and normal speech, you should be measuring at least 3 to 4 volts across the 0.47 ALC capcitor (negative to ground). Turn things off and make sure the power supply isn't holding some voltage. Then dig in at the 6CB6 and locate the 470-ohm resistor from pin 1 to ground. Lift the grounded end of this resistor and insert a .05-mf bypass capacitor to complete the ac ground path. Then run a lead from the resulting junction to the ALC capacitor.

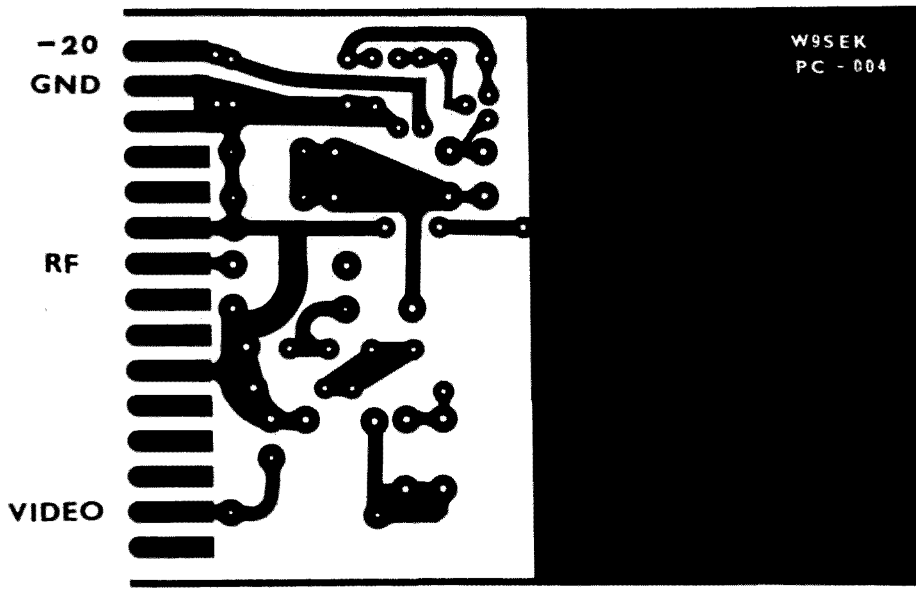
Connection of that lead closes the loop and completes the modification. The mike gain knob is now your ALC control. In the "12 o'clock" position, the one normally used here before ALC, action is the same as before except that the meter will never flicker above 150 MA on the loudest peaks. Twisting the gain wide-open raises the average meter reading, but it still doesn't flicker above 150—and at the other end of the line the other operator reports "It sounds much louder now, but it's just as clean as before." The new normal position is at about 3 o'clock, giving some ALC action at all times but leaving a healthy reserve for those bad situations.

At the same time all this was done, we did some general readjustment which also helped the performance. Major item was increasing the resting current from the recommended 25 MA to 60 MA, which represents maximum rated plate dissipation of the 'DQ5. Linearity as displayed by a two-tone scope pattern was helped drastically by this, which required nothing more than twisting the bias-control pot. In fact, linearity kept improving up to 100 MA, at which point no additional improvement could be noted since it was as perfect as our equipment could show. However, 100 MA leads to rather short tube life for the DQ5. Anticipated but not yet tested is substitution of the Tung-Sol type 8236, a direct plug-in replacement which has a carbon anode and is rated for 60 watts plate dissipation. This should allow a 100-MA resting current with ease.

But even without the 8236, the improvement in the Swan at W5PPE has been marked. Later stages of the on-the-air testing were conducted on the early-morning 3810-kc national round-table, where some typical comments were "It's like the difference between SSB and AM" and "Sounds just like a Collins". And a universal question was "How did you do it?" Now you know.

. . . W5PPE, K5JKX

Fig. 2. Layout of the PC board. Notice that this is the copper side.



Ronald Vaceluke W9SEK

TV Converter

For the video enthusiast who wishes to check out his camera or demonstrate it to relatives without a video monitor, the device shown here is just the thing. This is ideal for builders of the Eleemosynary[1] or similar cameras. The circuitry **(Fig. 1)** was borrowed from a commercial ITV camera and works quite well. Although I set my unit up on channel 3, there is no reason it cannot be used on any of the low band channels with appropriate crystal and coil changes.

The crystal is a 3rd overtone type at 30.625 (for Channel 3) and is resonated with L1 and C2 in the collector circuit. The emitter is tuned to 61.250 with L2 and C3.

Video of approximately 1 V P-P is applied to the input (terminate or bridge) and the modulated RF output is put into a conventional TV set. Output impedance is 75 ohms so a balun may have to be used on some sets.

Construction can be on a small punched board or printed circuit. Layout for the latter can be seen in **Fig. 2.** The contacts on the board match an Amphenol 143-015-01 PC connector. Although my board is 3½ inches high, only 1-13/16 is actually needed for the circuitry.

Adjust L1 and L2 for maximum output and L3 for maximum output consistent with good picture quality. . . . W9SEK

[1]Shadbolt, "An Eleemosynary Vidicon Camera for Scroungers." *ATV Anthology.*

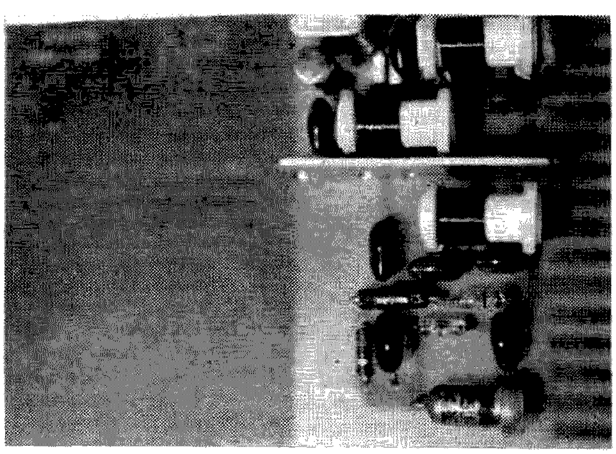


Photo of the component side of the PC board.

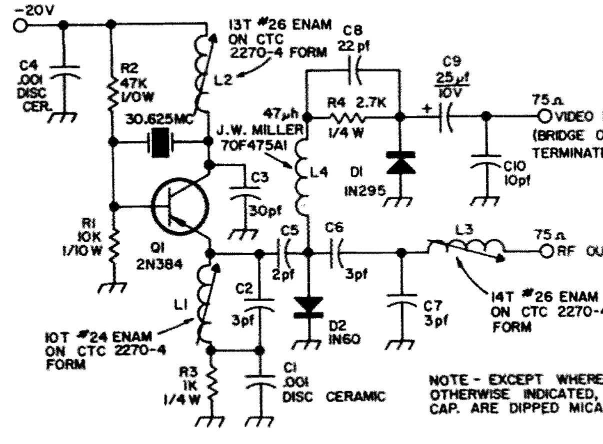


Fig. 1. The video to RF converter for ham TV or other uses.

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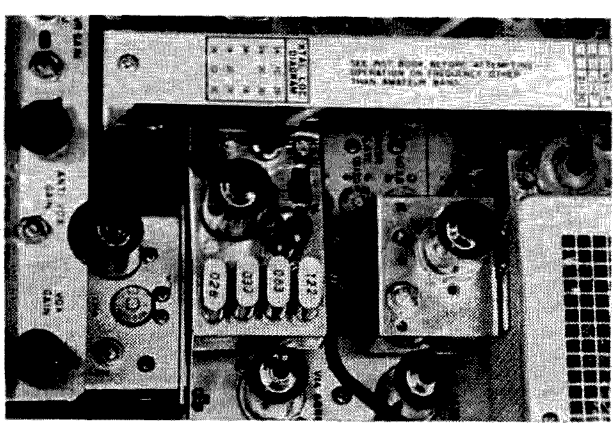
Crystal-Controlled Transmit with the KWM-2

Have you ever been on a DX-pedition with a transceiver such as a KWM-2 ? If you have, you found out the hard way that a transceiver is not flexible enough for fast contacts when the DX-gang jumps on your frequency. One way to dodge the infernal QRM is to work the boys away from your transmitting frequency. This can be done with a KWM-2— but what a job.

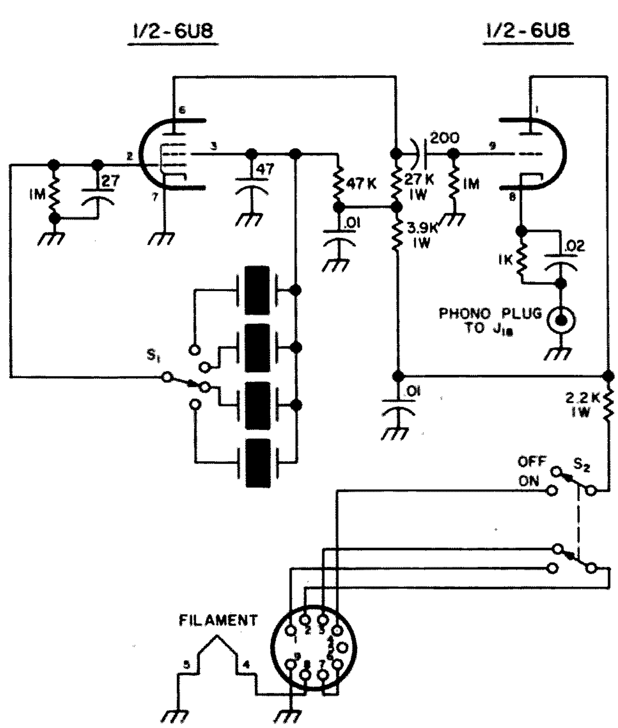
One answer to the problem is a crystal oscillator for fixed frequency transmission and tunable receive operation with the KWM-2. Such an oscillator is not only cheap but easily constructed to fit right into the KWM-2 without drilling a single hole into it. It makes the KWM-2 even more versatile, adding nothing to its size and only 4 oz. to its weight.

The pentode section of a 6U8A is used as oscillator in a circuit recommended by crystal manufacturers, while the triode section is used as a cathode-follower with the cathode return completed by R 22 and R 162 in the KWM-2. This arrangement gives more than ample drive and does not hamper normal transceive operation with the oscillator permanently installed. Switch S 2 is the only control necessary to go from transceive operation over to x-tal frequency transmit with tunable receive operation. Switch S 1 selects 4 crystals in the 2.500 to 2.700 Mc. range (International Crystals Co. Type FA-5) giving crystal controlled output in any of the 14 band segments. A 2.672 Mc. crystal gives an output frequency on 028 on the dial (14028, 14228, 21028, 21228, 21428 . . .). For other frequencies, subtract wanted dial reading from 2.700 giving the necessary crystal frequency. Ev: 2.700 - 122 = 2.578 Mc. x-tal. Output frequency will be on 122 on your dial in any band segment. RG 58/U cable with phono plugs on each side is used to connect the oscillator to J 18 (external vfo) in the back of the KWM-2. Tuning-up is done on a crystal frequency and follows the same procedure as in the instruction book.

The oscillator is built on a home-brew aluminium box of 2 ¾″ length x 1¾″ width x 1½″ depth. This box fits either into the space over J 24 (noise blanker) or J 17 (external vfo power). As I wanted to use the



Adapter installed in KWM-2.



oscillator with a Waters Q-Multiplier Mod. 340-PT installed, I had to fit it over J 24 at the same height as the PTO unit. A lip from the U-shaped box cover was used to attach it to the right hand screw which also fixes the PTO to an L-shaped bracket. This gives the necessary clearance for the 6U8A and also for the tuning cable of the Q-multiplier to pass between the bottom of the oscillator and J 24. Power and switching connections were made to the new external vfo power socket supplied with the Mod. 340-PT Q-multiplier by a cable and a 9 pin plug.

If you do not use a Q-multiplier, a male 9 pin chassis mounting plug can be installed into the bottom of the U-shaped box cover and inserted directly into J 17. A lip from the box cover should be used to secure the oscillator with a screw to the amplifier cage.

For 12 volt mobile operation, a 12CT8 can be substituted in the same basic circuit. Only the connections to the tube socket and to J 17 have to be changed.

Such a crystal oscillator was used in my DX-pedition to 9K3-Land and helped tremendously to operate the KWM-2 with pleasure under pressure.

. . . HB9TL

Illustrations by Wayne Pierce K3SUK

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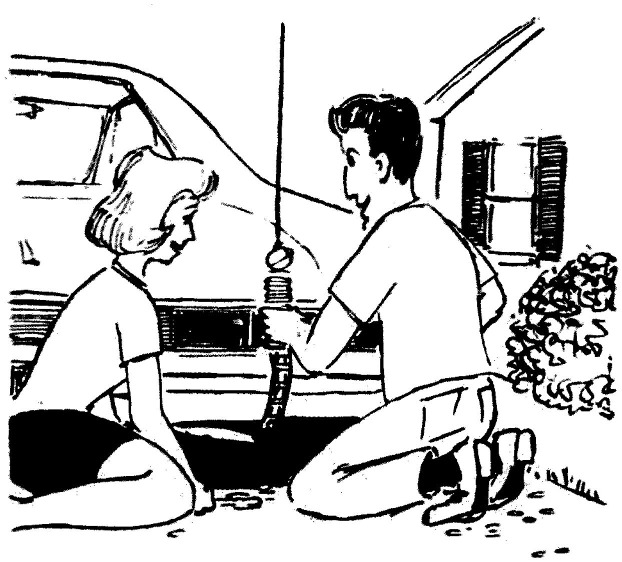
Lovers Lane

One sorry night I parked in lover's lane with a Ham Radio Operator.

This moonlit beach was a time-honored local courting tradition. Parking there was a precision operation that rivaled a military parade.

Cars parked in order of arrival. At 20 minute intervals the lights of a police patrol car would appear in the distance. One after another the cars would drive away in the opposite direction, circle the park, and then return for another quarter hour of uninterrupted parking.

The policeman who drove the patrol car knew full well what was going on, but he romantically maintained nothing "serious" could happen in 15 minutes. Besides, years of good natured cooperation by local couples in these evening beach-sweeping operations had made him a little smug, and somewhat permissive.



So far that season, there hadn't been one hitch in the operation, not even a stalled motor. Then I hit the beach with this Ham Radio Operator I'd been dating.

I should have known, when I helped him drill a hole in the trunk door of his brand new Pontiac, that something like this would happen. I should have foreseen it when I helped him install a six foot long whip antenna, adding a short, high frequency antenna to the roof of the car a couple of weeks later. But it was spring. Robins, tulips and my hormones were in full bloom. I was infatuated with this big, tall, hunk of beef . . er, Ham! He was, after all, quite a wonderful dancer.

When he invited me to go dancing one evening, I accepted, thrilled and planning what I'd wear before I hung up the phone. When he picked me up that Friday evening, the air smelled of fresh things; lilacs, bock beer, spring. I wore a daringly low cut dress of romantic blue chiffon.

We danced well together. His arms were strong and his shaving lotion was fresh, and I hardly felt the floor.

He whispered in my ear. I shivered delightedly. It was the first time he'd invited me to lovers lane. He was getting serious!

So we drove out to the park and took our place in the line of cars along the beach. We sat there, holding hands tenderly, drinking in the beauty of the spring night.

"Got to hand it to Sara Teasdale," I thought. "Is this beauty not enough? Why do I hunger after . . ."

"Spfttptz" went the box at my feet.

"What's *that?*" I demanded, pulling my hand away.

"My squelch."
"What?"
"My squelch."
"Oh."

He bent over, adjusting knobs on a metal box attached to the dashboard. I could just make it out in the moonlight.

"On my radio," he explained, head between his knees.

"What's it for. Do we NEED music?"

"On my HAM radio."

I sat there.

"See," he explained, coming up for air, clutching a two-way mike, "instead of being on all the time, the squelch cuts off bad transmissions. You hear less static."

"Great."

"Listen, I'll search the band."

"Search it," I said bleakly, putting my back and elbow against the window, leaving a wide expanse of seat between us.

"If I'm lucky, I'll get Detroit across the lake."

"Bully," I said.

"I'll see if there's anyone on. CQ, calling CQ, this is W9### calling CQ. Anybody read me?"

"Splutt pfzt," said the squelch, "przft."

"Jiggers," I said. "The cop is coming."

He was beyond me. "CQ," he invited the air waves, "calling CQ. This is W9###, on the shore of Lake Michigan, in Indiana. Calling CQ. Anybody read me?"

"Not yet," I said, "but stick around. Somebody will."

The lead car pulled out. Our turn came.

"CQ," he said.

The car to our right backed up angrily, clumsily, and the rest of the line followed it out of the park. We were alone on the beach, almost.

"All right, you two," said the voice of the law. "Break it up. That's enough. This is a public . . ." his voice trailed off as his flashlight searched out the dismal truth.

"Oh, hello officer," said CQ. "I'm trying to get Detroit. Listen! I think there's somebody on."

"Yeh," said the officer dumbly, as CQ frantically whirled dials from left to right. "Yeh," he repeated.

"Yeah is right," I agreed, shifting my weight a little. My foot had fallen asleep.

"Spfllftsz," said the squelch.

"I was sure I'd get good reception tonight," muttered CQ.

"You could have, you could have," I thought bitterly.

"Have you ever read *Spring Night*, by Sara Teasdale," I asked the officer.

"Nah," he said dully. His eyes had a detached look. He couldn't seem to move from the window ledge, where he leaned on his arms, the flashlight shining haphazardly across the bumper.

"The whole schedule's shot," he muttered pitifully. He stood there, stricken, as the line of cars began approaching the beach from the other direction.

"Officer," I consoled. "You are not alone. How would you like to buy me a cup of coffee and drive me home?"

"Yeh," he said dismally, as I opened the car door.

"Where are you going?" demanded CQ, startled.

I pulled my coat high around my throat so I wouldn't catch a cold in my cleavage.

"To Detroit, sweetie." . . . Marianne

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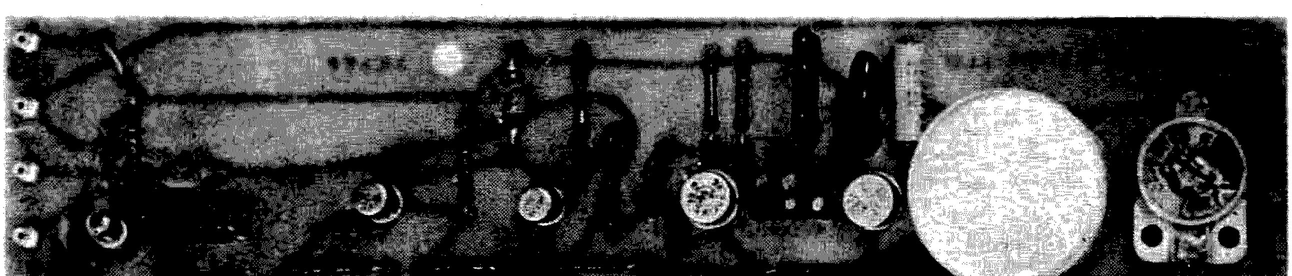
A Modern Frequency Standard

Like all hams who convert surplus equipment or build their own gear I have been faced with the problem of calibrating it. If you are interested in odd frequencies that are not covered by the new ham band-only receiver, you've got problems too. On the other hand if your budget is limited (and whose isn't), it is not practical to buy a new piece of calibrated equipment for each project. After being spoiled by having access to frequency counters and synthesizers at work, it is hard to ever go back to the old inaccurate methods of calibration. What I wanted for my station was a rock solid device that would approach the accuracy of the better commercial devices.

A little applied brain power will give several solutions to the problem. First one might try a harmonic generating oscillator. These have been used for a long time and are quite reliable. Another thought is the slightly more exotic frequency counter; it's really quite simple because of the repetition of simple flip-flop circuits. Some research into *Frequency* magazine or some of the other more specialized journals will add plenty of other possible combinations of flip-flops, Schmitt triggers, adders and so on, which may all be put together in any number of ways to arrive at the required answer. Being a little hard-nosed about it all, the simple calibrated oscillator appears to give you the most for your dollar.

Naturally when one thinks of calibrated crystal standards, the first thing that comes to mind is the self-contained, one tube oscillator and power supply of years past. This was and still is a good means of calibration for many people (including me. It is not complex, cost is reasonable and it may be adjusted to agree with the National Bureau of Standards by beating it with WWV.



A portion of the printed circuit board containing the modern 100 kc calibrator. The rest of the board (not shown) contains flip-flops, mixers, gates and a dirty picture or two.

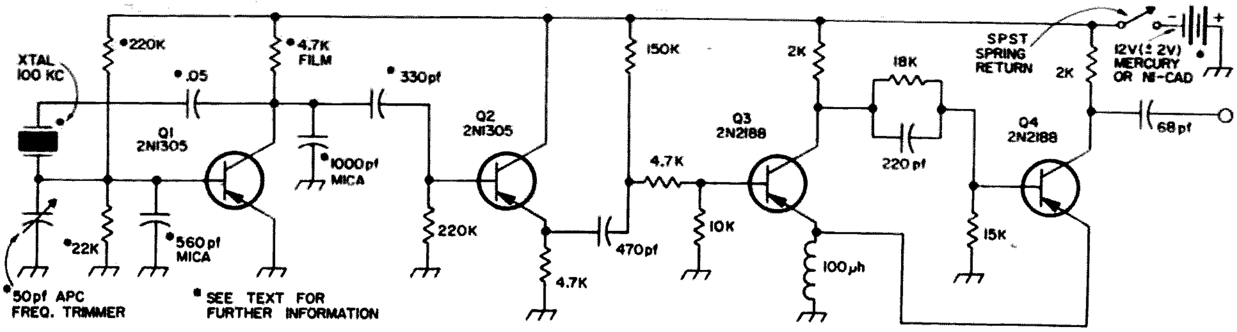


Fig. 1. Schematic of the modern 100 kc calibrator.

Let's get modern about this thing. After all with a little shopping around, for example see some of the ads in the back of this magazine, it is possible to put in four transistors for the price of a single tube. Not only that but you will find that there are almost no shocks involved in transistors which means a lot to us who have grown up the hard way with high voltage. Power supplies may be eliminated by using batteries, thus assuring yourself of a completely filtered "pure dc" signal which can be carried anywhere.

To accomplish these objectives to my satisfaction, the circuit of **Fig. 1** was arrived at after several months of mulling it over. It all starts with the 100 kc crystal oscillator. This is a highly stable circuit which will allow frequency measurements to be made that are far in excess of the general ham requirements. To obtain the best results the whole device may be enclosed in an oven which operates at a temperature somewhat above the highest expected ambient temperature. Common temperatures used in commercial practice are 75° C. in conjunction with tube type equipment and sometimes 50° C. when all other equipment is transistorized. We won't need the five parts in ten to the eighth accuracy here so let's settle for no oven and simply place the finished unit in a location where it stays just about room temperature.

If you will notice the circuit again, it is easy to see that there is a great deal of capacitive swamping used in the Pierce oscillator. Please don't use just any capacitors here. Use the best—silver mica. It will pay off in stability. A word about zero temperature coefficient ceramic capacitors . . . for some reason they never seem to get that ceramic formula exactly compensated and some drift has always shown up when I have used them. The collector resistor should be over-sized so that it will stay cool and not deteriorate with time, better yet use a carbon or metal film resistor with known long life characteristics.

The same thing may be said for the two base biasing resistors (220 k and 22 k). A .05 µf capacitor is used to keep dc off the crystal, almost anything may be used in this position because the reactance is so low that some variation will go almost completely unnoticed. Note that the frequency adjustment capacitor is in parallel with a 560 pf mica. This means that a good deal of capacity change will be required before much frequency change will be apparent; nevertheless use only good quality variables such as NPO ceramics, air trimmers or better yet double bearing capacitors such as those found in VFO's. The 330 pf oscillator coupling capacitor should also be of a stable nature because it couples into the frequency determining circuits.

A word about crystals for the circuit. The one I used was surplus, not hermetically sealed, thus it was possible to play with it out in the open. No doubt there are many commercial crystals that will work perfectly but mine wouldn't hit exactly 100 kc. So with the trimmer set in the mid-range position, it was possible to adjust the frequency up to hit WWV by rubbing up the plating with #600 grit emery paper (lightly, lightly) with the unit turned on. After a few days aging, a little rubbing with a hair pin of solder brought the frequency to the exact spot required.[1]

Only one problem with this type of stable oscillator, the output is so clean that there are no usable harmonics. Besides if you want a stable oscillator, the last thing you should do is connect an unknown external load directly to it. One stage of emitter follower isolation was added so that the oscillator would look into a high impedance load. This means that the load on the oscillator is very light and will not effect the frequency noticeably.

After the isolating amplifier is one of the most useful electronic circuits you will ever find, the Schmitt trigger. In this unit it is used to shape the harmonicless oscillator out-

1. "Grinding Surplus Hermetically-Sealed Crystals", *QST*, March 1963, pp. 30-31.

put into a square wave that is rich with harmonics. There is no question with this circuit of "locking in" to the oscillator; it is automatically done correctly. In essence the Schmitt operates as a voltage level detector. When the input level exceeds a certain value, the input transistor suddenly turns on while the other transistor turns off. When the voltage falls below the critical value, the conditions reverse just as though the transistors were a single pole double throw switch. It can operate much faster than a mechanical switch naturally, but it will create the same type of harmonics. This is one of the best things about it. As shown in the schematic, I have been able to obtain usable signals up to 165 mc.

In general the harmonic strength seems to be governed by the speed of the transistors used. The 2N2188 (Texas Instruments) seemed to be the best for my purposes but 2N2128's and SB-100's worked OK. I expect that almost any high frequency PNP type would be alright. The other transistors are 2N1305's which are about as cheap as you can get. In any case they are stable and seem to work without a hitch as long as they are soldered permanently in the circuit. I don't recommend sockets or transistor shuffling from one socket to the next which invariably happens when they are installed. If you happen to have some silicon transistors, they will undoubtedly function well as long as the frequency response is up in the mc range. My next project is to try some NPN transistors such as 2N705's or some of the new 25 cent epoxy devices made by TI, GE and Fairchild. Naturally I would change the battery polarity before adding the NPN transistors.

The design center of the oscillator and the associated circuits is 12 volts. Don't worry too much about hitting this voltage right on the nose because it is the stability of the power supply that you are interested in rather than the exact voltage. A set of mercury batteries connected through a spring return switch will give you a calibrating signal any time it is required and the batteries will last practically forever. The mercury cells will supply a very stable voltage source until near the end of their useful life when the voltage will suddenly begin to drop drastically. If you insist on an ac supply, then try to regulate it using a pair of 6 volt zener diodes in series across the power supply output or in a series regulator circuit. The reason for the two diodes is that zeners in the 6 volt region have by far the best temperature compensation. If you buy one already compensated, it may cost $50. Of course, the cooler the diode runs, or the less it is required to dissipate, the better it will work, so build accordingly.

Once the oscillator is functioning, it is easy to think up many places to use it, in fact I would feel lost without it. For example, it may be used to calibrate a receiver very accurately. If you first know approximately the frequency to which you are set, you are "in the ball park." The oscillator harmonic will locate the exact 100 kc multiples up or down the band from that spot. By adding a dial calibrated with divisions 0 to 100, work from marker frequency to marker frequency. If, on a particular receiver, the dial must be turned 2.67 times between markers (a total of 267 divisions), this means that each kilocycle will be 2.67 divisions on the dial, or close to it. There might be some variation due to nonlinearity, but this scheme is far better than the approximate calibration silk-screened on most dials. The addition of a couple of flip-flop dividers can do much to refine the readings but this is another story.

Using the oscillator as a band edge marker, it is possible to push the station transmitter right up to the band edge where mere mortals fear to tread (don't forget about sidebands though). With the calibrated receiver, crystals may be ground down to MARS frequencies, or shifted within the ham bands. You can adjust the frequency of your 2 meter converter crystal so that you can read the kc divisions correctly and give frequency reports to less fortunate buddies who still think that buying a calibrated crystal will put them on frequency. But after you have played with it for awhile, there will be new tricks that you will discover.

Remember it costs less than $15 to avoid grey hairs and citations from the FCC. That's a pretty cheap ounce of prevention. . . .

. . . W5NUW

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The Baffling Totem

WHAT IS IT, you ask? Basically it is used to mount and enclose speakers. The unit I built will mount four speakers, but more or less can be used. One speaker is used for two meters, one for six, one for the low bands, and one for a spare.

WHY SO OSTENTATIOUS? is obviously your next question. Besides serving the fundamental purpose of enclosing speakers, I wanted a decoration to liven up my shack. If you have a similar need, believe me, this will do the trick. People visiting the shack for the first time usually express their initial impression by something like "what's that?" After which you have an excellent conversation piece to break the ice with all but the most timid of souls.

This unit also serves a third purpose, and will undoubtedly be a solution for many of you. I was faced with the problem of providing access to my shack for four separate coax runs, two rotator cables, a heavy ground wire, and space for any future needs. At first I tried running the cables down inside the wall, but this proved futile due to cross bracing in the wall which interfered with the cable route. I finally decided to cut a round two inch hole in the corner of the ceiling, and arrange the cables down the corner of the room. Well, fine and dandy, but how to cover up the cables? The Baffling Totem came to my rescue! I mounted it in the corner of the room, and the cables now run down the wall behind it, out of sight, out of mind.

If you are convinced that you should have a Baffling Totem, let's get started with the construction! The following information is for making a four speaker unit, which is one foot

wide and four feet high. I used six inch round pin cushion type speakers. You can change the size to fit your own particular speaker/space requirements.

Obtain a piece of ½ inch plywood, four feet long by one foot wide. You can probably find a piece already cut in the "odds and ends" bin at your local lumber yard. If not, then have them cut a piece off, as this will eliminate the need of a table saw to obtain a straight cut.

You will also need ten feet of one by two pine, plus a few scraps of ½ inch plywood to make the facial features. You will also need ¼ pound of four penny (1½") finishing nails, a handful of two penny (1") common nails, one dozen ¾" wood screws, a bottle of white glue, some epoxy glue, sandpaper, ¼ yard each of red, blue, orange, and green decorator's burlap, (or any color that you wish to use) eight round wooden knobs, (the kind you find on inexpensive wooden chests) six feet of ¼ round wood doweling, four 2 inch eye-bolts, and ten feet of ½" manila rope. Painting and finishing will be discussed later.

Start by laying out your design directly on the board with soft lead pencil. Take care to space the speaker openings (or mouths, if you please) evenly down the length of the board. On the plywood scraps, draw the ears and noses.

Now do all the required sawing. A saber saw, jig saw, or coping saw will do nicely. Glue and nail the one by two strips to the back side, countersinking the finishing nails. Fill all holes and cracks with plastic wood or similar filler. Now sand all pieces thoroughly. Be sure to round off the edges of the ears and noses. Don't spare the elbow grease here!

Now attach the facial features to the board by using glue, and wood screws applied from the back side. The eyes may be put on next, by using the mounting screws which come with the knobs. A dab of glue under each knob will secure them tightly.

Next come the teeth. Cut them from the ¼" wood doweling, and glue them in place.

After locating the positions for the speaker mounting bolts drill a ⅜" hole ¼" deep at each location, drilling from the back of the board. The mounting bolts are then set in place with drugstore variety epoxy. This method was chosen to eliminate any countersunk holes from the front.

The speaker openings are covered by stretching and gluing decorator's burlap to the back side of the board. The unit is finished by nailing the manila rope to the edges of the board with the two penny common nails. To keep the rope from unraveling at the ends, apply a dab of epoxy at the joint where the ends come together. Make this joint at the bottom of the board.

After mounting your speakers, you are ready to hang your masterpiece of creativity from the ceiling with two eye-bolts.

Well there you have it, a colorful, functional, inexpensive, off-beat item that will never fail to provoke comments when guests enter the room. It will also give you the strange feeling that you are not "quite alone" in the solitude of your shack!

. . . W7PXE

Bill Hoisington K1CLL

432 mc Solid State Local Oscillator

Among numerous reasons for building this set, a major one is that I have always liked going up in frequency. When listening to the awful mess at times on the "DC" bands my faith and enjoyment in amateur radio is upheld by thoughts of all that nice clean "air" on 432, 1296, and up! I mean actually operating, contacts, mountain topping, etc., including building and tuning up.

When I wrote "Getting Started On 420" back in 1946, I was running 80 watts to a 32 element beam in Rye, N.Y., and working three stations over in N.J. in one evening was a great thrill. This was a modulated oscillator by the way. Since then the band has become "stabilized". First the good old 5 (now 6) meter band, then 2½ (now 2), and now 432. I personally think the modulated oscillator days were far greater fun than the present stabilized operation, but perhaps, taking the "long run" view of the whole picture crystal control does allow more stations on at a time. (Where are they?) And, due to the so-called "bumper crop of babies" of which by now a large number seem to have gotten their licenses, I guess we'll have to use a crystal.

This brought to mind immediately the question of VFO? However, I don't think this is a problem yet on 432. I'll keep my favorite crystal-VFO in reserve for that deal.

Local Oscillator Chain

If you're an "operator," don't read any further. If you really want to know how to get to UHF with transistors, keep plugging.

As you may know from previous articles, this author plays no favorites between tubes and transistors. However, there is a trend appearing. Lot's of people in the TV world are building all kinds of UHF tuners with transistors in them. Brand new fancy ones. Some of the tuners also have such as yet unattainable items as "three gang capacitor, .5 to 30 mmf". Yes, you read it right, one half a micro-micro-farad to thirty! This fancy minimum capacity is required by the wide uhf range of channel 14 (470 mc) to channel 82 (890 mc).

New UHF transistors for these tuners have also appeared. And if the usual course is run these should not be $20, $40, or over $100 (a fact) as some have been in the past, but should get down to under $2. The 432 and 1296 megacycle amateur can profit by these items, so we will start with the transistor chain.

If you double every time, a 50.5 megacycle crystal makes a good beginning. This goes nicely up to 101, 202, and 404 megacycles, the desired local oscillator frequency for conversion to 28 mc *if*, with only four transistors. 50.5 megacycles is also a nice rock for six meters, although that is mainly a VFO band now. Starting high is good for another reason as well. It lets you use fewer tuned circuits in the local oscillator chain. For example, in the circuit shown, it is possible to detect only a slight amount of 454.5 megacycle energy (nine times 50.5) in the output if you tune for it with a good tuned power detector. Tuned base input circuits will remove any trace of this, or a simple 400 megacycle filter can be used, if you're that fussy.

Oscillator: I went all out on this. I wanted to make a good, fool-proof item. It is. The more so because it uses a patent pending circuit of mine, the Crystal Phase Reversing Oscillator. Don't be alarmed at that word phase. That simply means, in plain English, the time relation of one event to another. And it is easy to describe it that way.

Figure 1 shows the circuit. A piece of piezo-electric material such as properly cut quartz, will have a concentration of negative charge on one side and positive on the other when mechanically compressed or stretched.

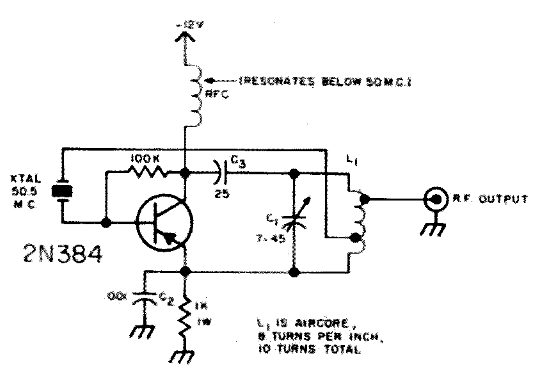
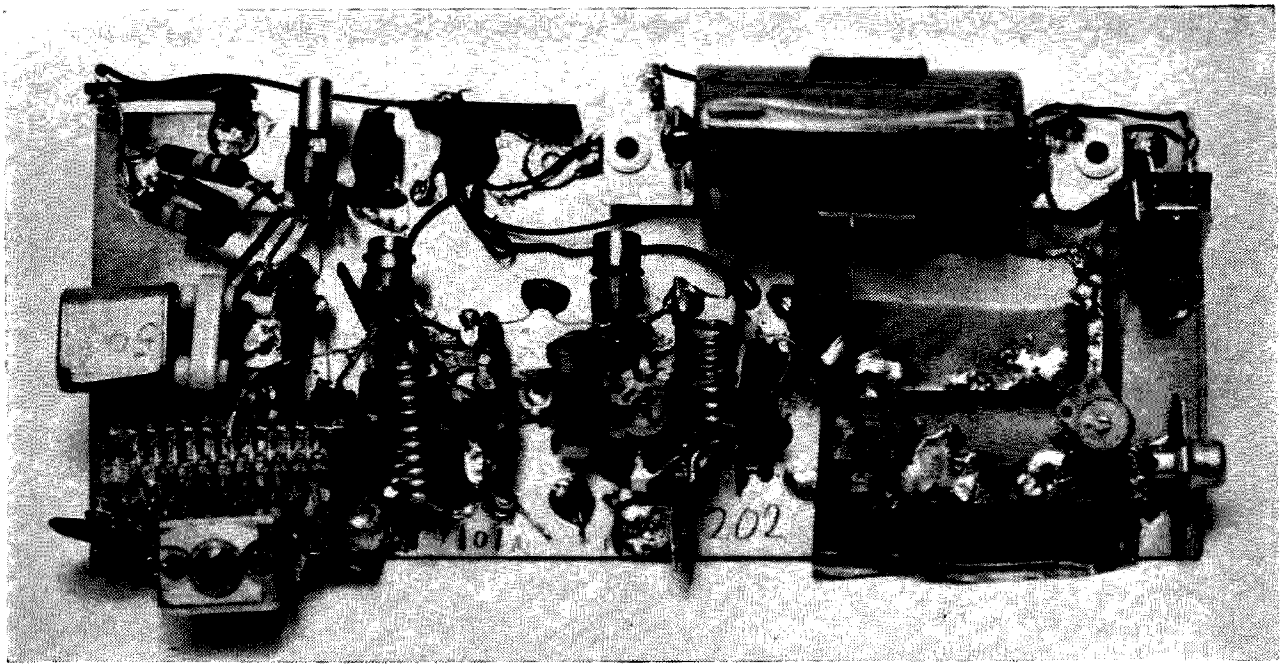


Fig. 1. 50.5 mc oscillator



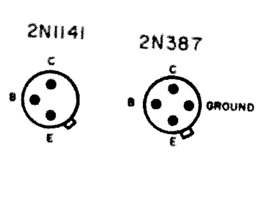
Top view of the local oscillator. Crystal oscillator is on the left.

Conversely, when a dc voltage is impressed across it, it will shrink or elongate. Going further, with ac on it, it will vibrate mechanically, and when doing so fast enough, these "sound waves" in the crystal material will bounce back and forth from side to side, being reflected at the air-crystal interface. To make a long story short, at any given instant there is plus voltage on one side and negative on the other. The next half portion of the cycle later, these will be reversed. So you see that the "phase" of the ac (50.5 mc) going through the crystal is always reversed. It's the nature of the beast. Incidentally, at least one patient examiner down in good old Washington, D.C. does not comprehend this fact yet. I finally had to send several photostatic copies of pages from textbooks on piezoelectricity down there!

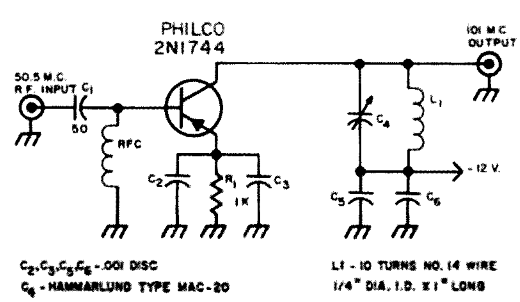
So it got to be a long story anyway. Meanwhile, back at Fig. 1, it will be seen that, rather than the base being at the opposite end of the coil from the collector, as it has to be in non-crystal circuits, the emitter is connected there. However, due to the lengthy process described above, the crystal reverses the phase, and not only oscillates very FB on frequency, but the circuit *refuses* to oscillate off frequency because, at any frequency except that of the crystal, the circuit is degenerative! Try it and see.

Back once again at Fig. 1, we have the ever-present 1000 ohm resistor in the emitter lead. This is bypassed by C2 to allow rf to drive out from ground. If you link couple out you do not need this bypass. The 100 k from minus 12 volts to base starts the oscillator running and keeps it going too, although under certain conditions it will run, once started, without it. I have used the following transistors in this stage. 2N247, 2N384 (good numbers), many of the VHF-UHF Philcos, and Motorola 2N1141. Some of these last go to 1296, so I saved them for the UHF 400 mc stages.

Watch out for the "ground" connection in some of these, see Fig. 2, and the collector connected case on some of them. Just be sure and get the base diagrams when you buy. And be sure whether you have a pnp or an npn. It does make a difference! I just burned out a brand new npn beauty, one of the 2,000 m



Above is Fig. 2, connections for the transistors used. To the right is Fig. 3, the first doubler.



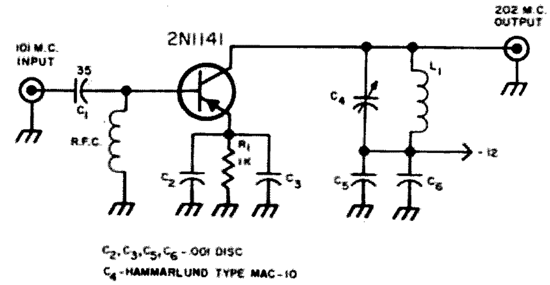


Fig. 4. The second doubler.

et. Simple rule to remember. Like electrons, which are "units of negative electricity" the npn's operate on positive voltage. (on the collector). That's about all there is to the oscillator. If you use the components listed and connect them as shown, it will work! It has to!

First Doubler, 50.5 to 101 mc

As usual, copper-clad bakelite makes a dandy breakboard. Mechanically strong, solders with a touch, cuts with a snips. What more do you want? A young, ready, willing and able novice yl to do it all for you?

Note in the photo that sockets are used. These are Grayhill because so far I have found them best. The thin small transistor leads insert easily enough, hold tight, and do not bind. There's a nice feature with sockets. You can try out your other transistors! I grade them for frequency this way. Plenty with the same number do not work the same!

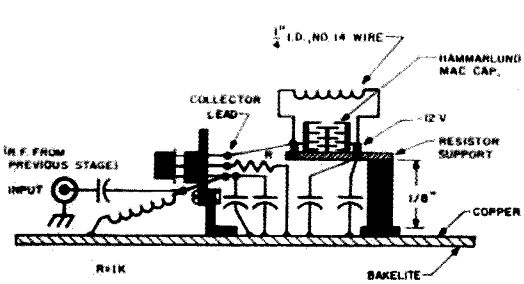
I have found an easy way to mount the little sockets too. A 2/56 nut and bolt will fasten a number 14 wire to the socket. This wire then solders to the baseboard and that's it. These sockets are still working at 400 mc also.

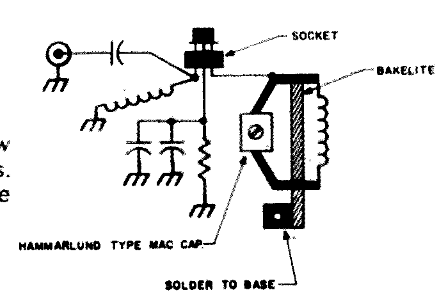
Note that the double bypasses on the emitter, and on the collector coil returns. This definitely adds to the power output, as you can see by tests. The more so as you go up in frequency. Of course, there is an old trick from way back before WW2, in the good old 5 meters days. You can deliberately put a choke in the emitter lead (was the cathode in those days) and have a regenerative doubler. You put a variable capacitor across the choke to ground, and as you went near the minimum the doubler would break into oscillation. However, and don't say I didn't warn you, such a stage can be a source of trouble. Amplitude modulation from mechanical vibration, instability, etc.

Figures 4A and 4B show some physical details. The resistor support is actually about ⅛ inch from the base board. The bypasses have practically no leads at all when properly connected. The Hammarlund type mac capacitor leads are also soldered directly to the resistor support tabs, which are cut and flattened. As you can see from Fig. 3, a transistor doubler stage can be quite a simple circuit, if you have the required components on hand. As the chain developed, I shifted the minus 12 volt lead going to a 10 ma meter to each stage as it was built. Without rf drive from the previous stage, no current will show, as the base is grounded through the rf choke and does not have any dc excitation on it. This allows a good tune-up procedure into the base circuit, similar go getting grid drive with a tube. In the chain shown, one or two ma showed on the collector milliammeter when the previous stage drove the base into the current region on negative rf peaks. The 1 k emitter resistor serves to limit this current. A little more power can be obtained with 500 ohm resistors and maybe 13 to 15 volts, but "as is" it works fb. No attempt at large power outputs was made, as this chain gives about 500 microamperes of good clean rf at 404 megacycles measured as rectified crystal current in the power detector test circuit. About 100 microamperes crystal current is found in the mixer crystal when the circuit is tuned to 432 megacycles.

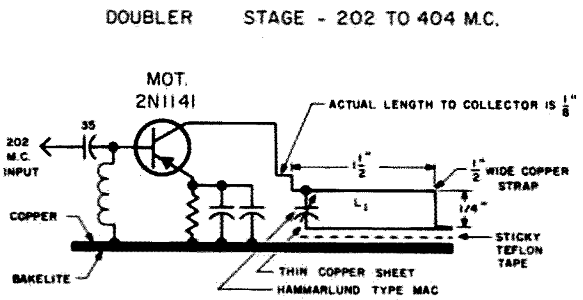
These mixers have previously been described in 73, so the complete block diagram is shown here, in Fig. 7.

Each multiplier stage is shown in detail as there are some changes as one goes from 50 to 404 megacycles. The collector circuit at 404 megacycles is of considerable importance. This uses the system outlined in an article on transistor multipliers in 73. A simplified version was tried and it works fine but may not suit you as a permanent circuit. This method

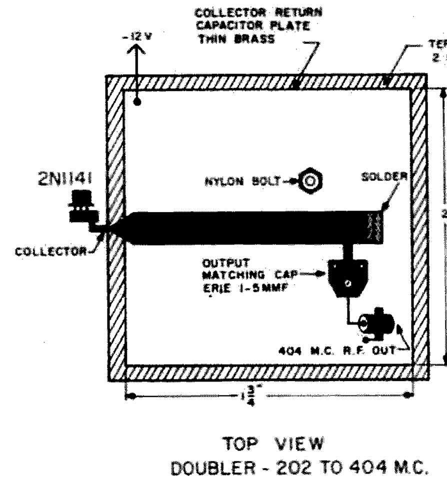




Left. Fig 5A. Side view of the first doublers. Fig. 5B. Top view of these doublers.



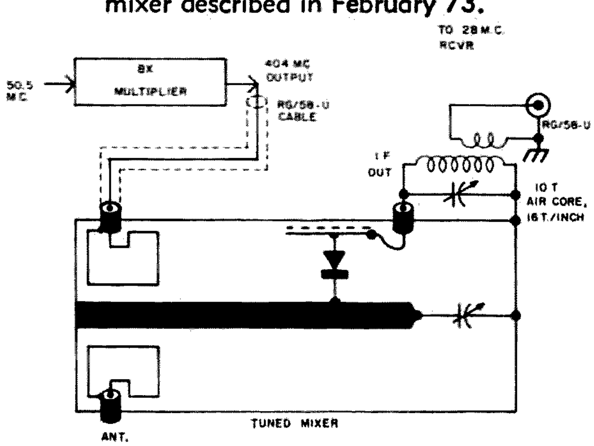
Top. Fig. 6A. Side view of 202 mc doubler. Right is Fig. 6B, the top view.



uses thin copper sheet for the collector return capacitor, separated from the baseboard by Teflon tape and held down by more of the same around the edges. For a more permanent method use .022 brass plate with the insulating material bolts and nuts.

It is of great importance to use doubling, in my opinion, and to be very sure you tune each collector circuit to the desired frequency. By great importance I mean that it is difficult enough to line up the whole rig, even using doubling only, without trying to triple or quadruple. An example. When making up the 432 megacycle crystal controlled in signal source, to be described next, the highest frequency crystal I had on hand that would go to 432 was a 27 megacycle unit. The oscillator worked FB so I proceeded with the next stage and tried it out as a quadrupler from 27 to 108 megacycles. Sure, it worked, tuned up sharp and all, but gave only about 30 microamperes on 108 megacycles. Putting in the doubling coil tuned to 54 megacycles gave an output of over a milliampere with no frequency ambiguity. That is, the first and largest glop of rf energy you come to going up from 27 megacycles with the doubler collector coil is at 54 megacycles. Be sure and check positively for resonance at the desired frequency. Remember that a transistor can sometimes put nearly equal power out at both 50 and 100 megacycles at the same time, under certain conditions.

Fig. 7. Block diagram of whole receiver with mixer described in February 73.



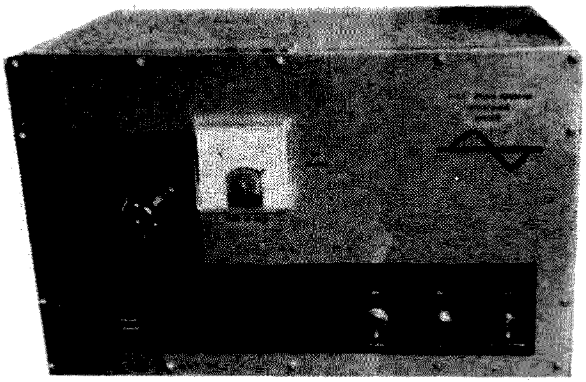
Assembly

At last we get to a narrow-band superhet system. There are two main methods of working on rf, mixer, and oscillator stages when up in the vhf range, and even more so in the UHF region. The first has already been described in the tuned mixer article, where you use a tuned first oscillator and a broad-band *if*. You *have* to use the broadband job. I defy you to hold a tuneable 404 megacycle local oscillator into a narrow-band *if* for more than a fraction of a second. Of course, every time you even go near the rf or the mixer stages you detune the oscillator. This is one of the reasons for the crystal control chain just described. There are others, such as hum modulation, long term drift, etc., but enough of that, let's hook up the three units and see what happens. This is the second method which calls for crystal control of the UHF oscillator, and also, another must, crystal control of the signal source. So I built a second chain like the first only starting with a low cost 27 megacycle crystal (I'll admit to having the odd call letters 1W1596, among others, but that's all I'll admit!) This came out on 432 megacycles and was modulated by a single 2N247 and attentuated with an exceedingly simplified and low cost device.

Plugging the local oscillator chain into the tuned mixer and a 28 mc output coil into the mixer crystal, this was link coupled to the 28 mc band of my Morrow receiver. The signal came slamming in over S9 on the meter exactly on the black line of 28 megacycles on the dial. Of course, it is *supposed* to do this, but how often does it?

Figure 7 shows the block diagram. It works. This whole deal makes a nice low cost 432'er front end.

. . . K1CLL



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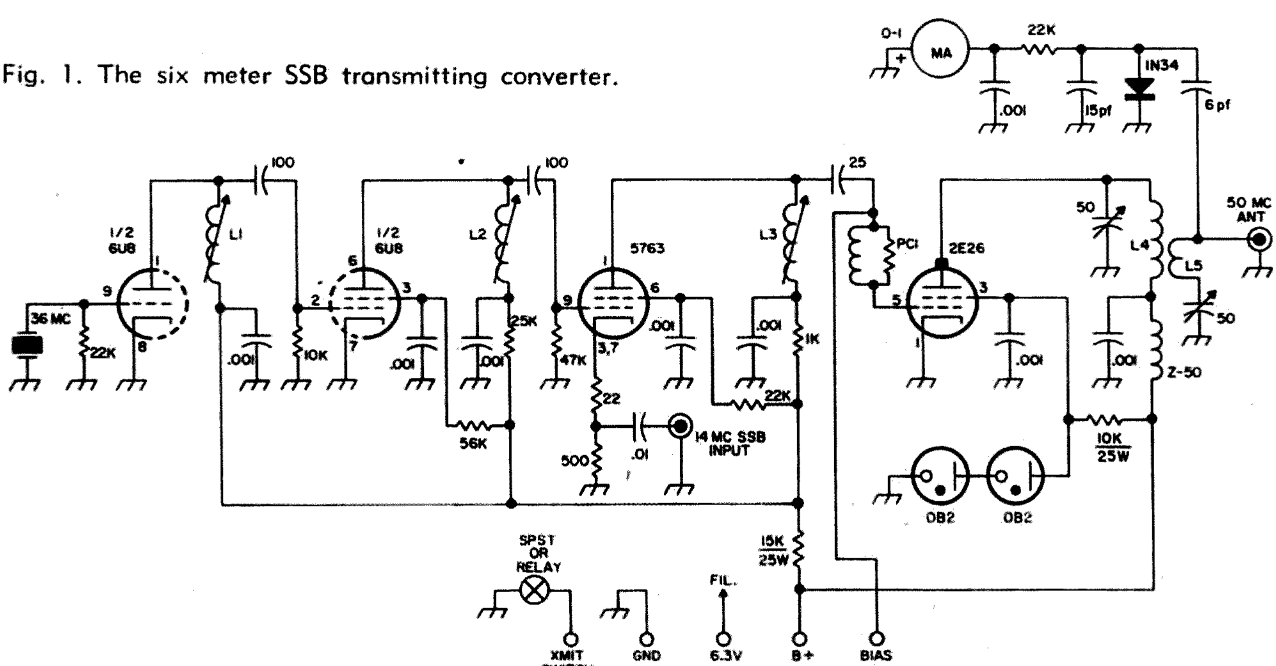
6 meter Transmitting Converter

Wishing to get on six meter SSB and not having the cash necessary to purchase any of the few commercially available transmitters, I decided to try my hand at designing and building some sort of hetrodyning unit to use with a HF SSB exciter. I located a real clean Central Electronics 10B phasing type exciter, wound a set of 20 meter coils and went to work on this project.

The oscillator-buffer is more or less a standard overtone circuit using an International Crystal type FA-9, 36 mc crystal and slug-tuned coils. I used a 6U8 tube however a 6EA8 may be used if on hand. As usual, keep all leads short as possible. Voltage to oscillator may be regulated, however I did not and have had no trouble with instability. Tune up is accomplished by merely adjusting both coils for maximum output consistent with oscillator starting every time voltage is applied.

The mixer is a 5763 with 36 mc RF injected at control grid and the 14 mc SSB RF injected thru a voltage divider at the cathode. The voltage divider shown was right for the output of my 10B and will be correct for any exciters with approximately 10 watts output. From my

Fig. 1. The six meter SSB transmitting converter.



own experimentation and consulting other home-brewers, it was found that the ratio of 36 mc RF to 14 mc RF presented to the mixer should be 8 or 10:1 for the mixer to work most efficiently and give correct output. I originally tried injecting the 14 mc RF thru a tuned circuit with link coupling at the screen of the 5763 but I found there was too much RF available and too much appeared in output of amplifier due to mixer apparently being over driven at that frequency. Actually cathode injection is easier and requires one less tuned circuit to fool with.

The linear amplifier used is a standard type and either a 2E26 or a 6146 may be used depending on bias voltage and high voltage available. For a 500 volt supply and a 2E26, as shown, the bias should be between −15 & −22 volts; a 22½ volt miniature hearing aid or photoflash battery works nicely and may be permanently soldered into the unit as it will last for almost shelf life. For a 500 to 800 volt supply and a 6146, bias should be between −40 & −50 volts with a 300 volt source for other stages. The screen voltage in either case is a regulated 210 volts. I did not find neutralization necessary in my unit but depending on tubes used and the builders contructional practices, it may be necessary in some units.

General constructional details are left to the individual builder but I will stress again the need to keep all leads as short as possible. My power supply was made from a TV power transformer, surplus filter choke, and 4 50¢ silicon diodes (750 ma @ 750 piv). The cabinet for the unit was hand made using aluminum angle and sheet aluminum, dimensions made to duplicate the 10B cabinet. After testing, the only meter used in the final unit is a 0-1 DC ma with a standard diode detector indicating actual RF output at antenna connector. The only control brought out to the front panel is the final tuning other than power supply switches and pilot light.

In six weeks of use I have had many compliments on the unit. Its total cost to me was the aluminum angle and the piece of self-adhesive vinyl which decorates the front panel, however, even buying parts new, the cost should not run over $20 or so. Plans are now in the making for a two meter unit.

Good luck on VHF SSB and I will look forward to seeing you on six or two.

. . . KØAHD

Coils

L1, L2 . . . 9T #20 wound on ⅜ inch slug tuned coil. Resonate at 36 mc.
L3 . . . 6T #20 wound on ⅜ inch slug tuned coil. 50 mc.
L4 . . . 3T #18, 1 inch diameter, PIC 1746.
L5 . . . 2T #20 link inside L4.
PC1 . . . 4T #20 on 47 ohm 1 watt resistor.

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The VHF Newcomer

Since the initation of the VHF column in this magazine I have received a number of letters from new licensees, and some that were not so new, asking for information on how to get started on VHF.

After looking through several years of the amateur publications it is obvious why these letters were received. The newcomer to VHF has been virtually ignored in the maze of pump oscillators, moonbounce, satellite antennas and the like. Granted, this reflects the advancement of the state of the art, but doesn't offer the neophyte the information he needs.

All of the questions have centered around the basic pieces of equipment . . . transmitters, receivers, converters, antennas and transmission lines.

This article is intended for the newcomer and I hope it will offer a suggestion and answer or two.

In general, bandswitching transmitters for VHF are inefficient because of the wide separation of the frequencies involved.

You will notice very few of the construction articles include bandswitching rigs. They are generally more complex and less efficient than single band equipment. There are a number of excellent single-band transmitters described in the *VHF* handbooks, *73 Magazine* and *QST*.

The only draw-back of a single band transmitter is that you will have to decide which band you want to operate, or build two rf sections and use common modulators and power supplies.

Which band should you choose? This depends entirely on you and what you want to do. However, I would suggest you select either six or two meters because things are not as sticky on these frequencies and they offer a good place for practical experience before tackling the higher frequencies.

You fellows who live in high population areas will find activity on either band. Those of you who live in more sparsely settled areas should check around and find out which band is being used most, unless you care to pioneer.

Six meters will offer consistent groundwave contacts over a one-hundred mile radius or so depending to a large extent on how much power and how good of an antenna you're using. Some of you will disagree with that statement, but remember I'm talking about an "average" station operating under "average" band conditions.

During the late spring and early summer months, and again in December, (although it can occur anytime) sporadic E becomes the fancy of the six meter man. Signals, propagated in the E layer, can cover distances to about 3,000 miles with exceptional strength from even extremely low-powered transmitters.

'F' layer openings occur during years of high sunspot activity and a number of stations have worked all continents and many countries. These signals are similar to those propagated on the low-frequency DX bands.

Another form of propagation, which you can't believe until you hear, is auroral reflection. Under certain conditions, radio signals can be reflected off the auroral curtain and cover distances up to several hundred miles. AM signals are badly demodulated by the aurora. CW or SSB is a necessity.

There are other forms of propagation available on six meters, but most are beyond the scope of the beginning VHF operator.

Two meters offers some of the same types of propagation as six but comparisons are difficult.

In general, groundwave conditions are somewhat better than six with tropospheric bending entering the picture. At times, this

allows contacts over several hundred miles with strong signals.

Sporadic E skip can, and has, happened on two meters but it is not common. When it does, signals are similar to six meters.

It is doubtful if 'F' layer openings ever occur on two meters because solar radiation would have to be extremely high.

Auroral propagation on two is similar to six although signals usually are not as strong. However, at times there will be auroral propagation on two when there is none on six.

Also, there are other forms of propagation on two meters but they fall under the same classification as stated about six meters.

These comments about propagation are intended as only a rough guide as to what to expect, there are exceptions and volumes have been written on VHF propagation. Much is still to be learned about propagation on these frequencies.

Transmitting powers of 25 to 50 watts are generally adequate on both bands for the types of propagation mentioned. High power does help and you will probably want several hundred watts after you get your feet wet.

By all means have your transmitter capable of CW operation as well as phone. For a given amount of power CW will cover more miles per watt than AM phone because none of the power is wasted in generating sidebands unnecessary for communication. Don't shy away from CW. It is fun and the majority of VHF'ers use slow speed CW or will slow down if you ask. Slow speed CW is helpful on long-haul groundwave work when signals are rapidly changing in strength.

When building your modulator, figure how many watts of audio you think you will need and then double it. Audio, or lack of it, is probably the biggest single fault to be found with VHF AM rigs. A well modulated signal will be readable even though the strength may be near the noise level. Those of us who have operated on the VHF bands have tuned many signals that were strong enough to work but because of lack of audio were no more than a senseless carrier. I can not stress the need for plenty of modulation too highly!

Now for the station receiver. Most of you have a separate receiver of one kind or another in your shack. Whether or not it will do an acceptable job on VHF is another thing.

Very few of the so-called all-band receivers are really good in their VHF range (unless they have a built-in converter) but will satisfy most newcomers. The usual shortcomings of

these receivers are lack of image rejection, stability and calibration as well as high noise figure.

The most common receiving system used by experienced VHF operators is a communications type of receiver with a crystal-controlled converter feeding into one of the ham bands (*if*) at 40 meters or higher depending on the receiver and how it functions on the higher bands. The *if* that is probably used the most is 14 megacycles, or if you have a receiver in the Collins class a 26 or 28 megacycle *if* would be the best choice.

There are many good used receivers available for the same money, or less, than you would pay for some new receivers which would not serve your purpose nearly as well. Read "Evaluating Receivers" on page 52 of the December 1964 issue of *73* for some good tips on buying a used receiver.

What kind of a converter to put ahead of the receiver? If you have a well-stocked junk box, or know someone who has, you may want to build. All of the magazines and handbooks have circuits and construction information. Briefly, use good components, plenty of shielding, short leads and take your time. Whether you build around tubes or transistors is up to you of course. However if you choose tubes, I'd suggest Nuvistors . . . and there are many transistors available that will give the best Nuvistor a run for its money.

If you don't have the necessary parts and have to buy them you will probably be ahead (dollar-wise, not know-how) to buy a commercial converter. There are many available. Some are good, some are not. I'm not going to mention my choice as being the best for obvious reasons. Most of the Nuvistor models are pretty good. Mass production does not allow every manufacturer to align a piece of equipment perfectly for competitive cost reasons. Depending on the band and whether or not it has a built-in power supply, you can expect to pay $35 to $55 for a good converter. Check around with some other VHF'ers and determine what they are using for a converter.

Dollar for dollar, you are likely to improve your VHF station the most in the converter and antenna departments.

Now about those controversial pieces of aluminum known as antennas. The various VHF handbooks and amateur magazines have several excellent configurations which can be built with materials starting at about $5.

I believe it would be safe to say that most VHF operators, except some of the old-pro DX'ers, buy a commercial antenna.

Here is a place where you can really get "taken-in" if you believe all that some manufacturers claim in the way of gain and front-to-back ratio. Ask around and do some reading.

Obtaining a good beam solves only half the antenna situation. The installation deserves careful consideration.

Use a good quality of coaxial cable or twin-line. Both come in various impedances, material, loss factors and prices. If you choose coax make it the polyfoam variety, RG-8 for 52 ohm or RG-11 for 72 ohm. Don't use RG-58 or RG-59 because they absorb too much received and transmitted RF at VHF frequencies. And if you select twin-line, select the type intended for transmission purposes, not the so-called TV stuff. It also absorbs too much precious RF. Connectors? The UHF type will get you by, but types N and BNC are better.

Now that you have a beam, feedline and connectors, where to put them? You can't put the beam up too high. Your pocketbook will dictate how high it will be. If you can't get the beam well up in the air, at least mount it several wavelengths from the nearest tree or utility line. Both will tend to absorb signals, and in the case of power lines, introduce noise into your receiving system. Many have done very well with a beam mounted in the clear and only 25 feet high, but a 40 foot height is a reasonable place to start.

No matter where, how high or what type of a support you choose, you will want to be able to rotate the beam. Almost any of the TV rotors will handle a VHF antenna of the type we are talking about. Some offer thrust-bearings for added strength or they may be purchased as an accessory for a small amount. And choose one that has a direction indicator of some type.

On the other hand, if you're not able to purchase an automatic rotator there is always the "arm-strong" method, (turning it by hand.) But who likes to go outside when it is 20 below zero or raining. It never fails.

Well fellows, that's it in a nutshell. You can get on VHF for as little or as much as you wish, it is entirely up to you. There are many kilocycles in the VHF spectrum just waiting to be used for experimentation or cross-town, QRM-free QSO's.

I hope this article has answered some of the questions you newcomers have, and if you have any specific questions drop me a line. I'll try to answer them or refer you to someone who can. That is how WØPFP gave me my start 8 years ago.

Good luck to you on VHF.

. . . KØCER

Gus Browning W4BPD

Gus: Part VII

In last month's issue I had cleared Czech customs with the assistance of my Red Star badge, or an Auspice Day, or my usual dumb look. I was on my way to Munich, Germany, to see some of my friends. After an uneventful train trip (at least it was uneventful after getting in Germany) the train arrived in the big Munich railroad station at midnight. I wandered to any number of hotels and found that it was impossible to get a room. Some sort of international convention was taking place and all the hotels were filled. Now what would you do at this ungodly hour of a chilly night in a strange city? Well, back to the railway station I went and walked up to the ticket window and said, "Give me a ticket to Vienna, please!" After about 4 or 5 hours' wait I was on my way to Vienna. After that it was Zagreb, Yugoslavia; Sofia, Bulgaria; Bucharest, Rumania; Budapest, Hungary; Warsaw, Poland; Copenhagen, Denmark; back through Hamburg and Frankfurt, Germany; on to Luxembourg. Then Paris and to Andorra in the Pyrenees; Lisbon, Madrid, Barcelona, Gibraltar, Ballarec Islands, and Marseilles, and on to Viernheim, Germany to visit Hans DL3JJ.

Up to now I had only been a tourist ever since I had left Munich with their filled-up hotels. I had no one to visit in these countries between Munich and Viernheim; I had not yet received my equipment. These trips through Europe were by train and bus, the costs being very low, and I had a wonderful time just seeing these places, if for only a few days at each spot. I had no definite schedule on this portion of the trip; I just stayed at each place until I figured it was time to move on. Incidentally, this is the best way to make any trip if you have the time and are not in a hurry trying to meet a tight schedule.

I got off the train at what I thought was Viernheim; later on I found that it was some other 'heim not spelled with Viern. To be truthful, I was not pronouncing the name properly to the train conductor and he let me off the train at what I suppose was some town that I was kind of pronouncing. Now this was about 5 a.m. No one was at the railway station and I wandered up the street of this little German town. Very few people were on the streets at that hour. I asked a policeman how to find DL3JJ's home, and he spoke no English at all. I continued up the street trying to question other people, and not one of them spoke any English. Finally I stopped in a service station and the attendant could not speak English either, but while I was trying my very best to talk with him and not getting anywhere at all, a truck stopped in for some gasoline and this driver did speak fair English. He even offered to take me to DL3JJ's QTH, which was about 20 miles out of his way.

Upon arrival there I found that Hans had a small electronic manufacturing business in his back yard, but that Hans was away on business. Working for him, however, I found Mahmud SU1MS who welcomed me, took me down to a nearby small, very neat German hotel and checked me in and in the end paid my hotel bill for me. Mahmud gave me a note written in Arabic with a telephone number. He told me when I arrived in Cairo, Egypt, to call this number and I would be

taken care of in good style. Hans was building some of the very nicest precision measuring equipment I have ever seen. Direction finding units for their FCC was an item he was making when I was there, a very beantiful piece of gear.

Mahmud was just as nice a fellow as I had thought he was when I worked him on CW. I have found that everyone I had QSO'ed, even on CW, and formed an opinion of usually was the type of fellow I expected him to be. I cannot say the same holds true of how you picture people to appear. This will fool you, and I mean nearly every time.

After spending a very pleasant few days with Mahmud, meeting Hans' very sweet mother and a YU chap that also works for Hans, I departed for Nienburg to visit Hadi DJ2PJ.

I found that Nienburg was another typical small German town where nearly everyone knows everyone else. All the people I met there through Hadi's introduction were most friendly. They offered me German beer, which I very gracefully turned down since I am a 100% non-drinker of anything containing alcohol, so we all had a cup of good German coffee. Sometimes I even ran into a Coca Cola. Hadi speaks very good English, I understand he teaches it in school. His parents were very friendly and nice to me; I stayed at his home and did a little operating of his station. After spending a most enjoyable week with Hadi and his family I departed, again by train, for Hamburg and another short eyeball QSO with Gus DL6ZZ and his nice XYL, Helene.

A phone call to Amsterdam Airport informed me that my radio equipment had arrived and was QRX for me to pick up. Off to Amsterdam by train. Upon arrival I immediately took a taxi to the airport and located my equipment without any trouble at all. Yes, locating the equipment was no trouble, but getting it was the rub! In fact, they more or less told me that they would not release it to me. I tried to tell them that I was on my way to Monaco and that was where I wanted to use it. They said FB, we will air freight it to you down there. I asked them how about sending it by train. But when they told me the costs to send it by train I was floored. There were all kinds of charges tacked on: airport handling, railway charges, the charges down in France, tax and other charges. In the end it was much cheaper to have it sent on down to Marseille by air freight.

I was learning a little about some of the many troubles and costs of shipping things around instead of carrying them with you as surplus baggage. Of course, surplus baggage costs more, but after giving many thoughts to the various difficulties you run into when things are shipped separately, it's by far a better idea just to pay the added costs of air freight. Then you don't face the problem of your equipment not being there when you arrive, and customs is a lot less trouble when you have things along with you. As a rule customs at the airports is in just as big a hurry to let you pass through as you are. Generally they don't have any place to store things at the airport and this makes them want you to take your equipment along with you. Of course, cut down every single ounce, because in the end they will cost you bucks! I know nearly everyone who makes a trip abroad takes by far too much clothing, just as I did at the beginning. Somewhere during my trip I sat down and gave lots of thought to this big batch of clothing I was lugging all over the world and decided I was going to cut this to the bone. I shipped home everything I had with me except the following items: 3 pairs of undershorts, 3 undershirts, 3 shirts, 3 pairs of pants, one pair of shoes, 3 pairs of socks, one sweater, and one dress coat. You can put all this in a small air passenger bag. Right now I have even cut this down to just two changes of clothing. Be sure everything you have is the very best you can buy and is drip-dry; wash your clothes every night and hang them up over the bath tub (if there is one) and the next day you again have two changes of clothing. Of course, if you are going to be where it's cold you have to carry a few heavier things with you. It's actually a lot cheaper in the end to carry the bare essentials and BUY what you need along the way.

Well, after shipping my equipment from the Amsterdam Airport I boarded a train and made a slow trip on through Holland, Belgium, and France on down to Marseilles. Upon arriving there I checked into a small hotel and waited three or four days there for Leny (then VQ4GT—ex-VQ8CB and VQ8AB), his XYL Lillette and daughter Gertie to arrive. It was quite an experience there. I hung around some of the waterfront places looking at all those people drinking all that wine and I saw some of the doggondest dancing I had ever seen. They called it "The Apache," and it's real rough stuff. They throw the girl down, pull her up by the hair, slap her face and also slap other parts of her, and a lot of other rough stuff like that. But she likes it and keeps coming back for more!

Leny and family arrived and we met for the first time, after the many QSO's we had had.

We each had written the other as many as a hundred letters, exchanging photos of our families and I thought we knew each other quite well. I had told Leny all about my exact financial status and everything else about me that I could think of. I don't know what kind of fellow he expected to see when he met me, but here I was, a little fellow living in a cheap hotel, pinching every penny. I was not the Rich American that people usually expect to meet overseas. Any of you fellows who know me personally know I don't try to put on a Big Front just to impress people. I try to always be humble and as unassuming a fellow as possible. To put it mildly, I think Leny and family were a LITTLE bit disappointed in what they met. In the end, though, we all had a fine stay in South France, traveling all over in Leny's new Volkswagen helping to make the mileage high enough so that he could take it back to Kenya with him as a "used car." As it turned out, Leny took me all the way to Monaco.

There I went to the Hotel Le Siecle and told the man behind the desk I was a radio amateur and wanted a room. He said, "Yes, I have been expecting you and I have a room on the top floor waiting for you." At the moment I thought this was rather odd, because I had not told anyone I was going there, but to save an argument I just kept my mouth shut. We went up by a stair case that ended up right on the roof. There were four nice 25 or 30 foot poles lying on the roof (it was a flat cement roof with a wall around it). There were even four metal bands mounted on this cement wall for the poles to be mounted in! I was taken to room 39, where there were two tables end-to-end at the back window to set equipment on. He said he had fixed it all up for me to use! I could see that DX'pediting in Monaco was going to be a lead pipe cinch; everything was all set for me even before I got there! The manager told me he always gave hams room 39.

That afternoon I was directed to the Ministry of Finance to see about my license. I walked in and told the pretty French secretary what I wanted, filled out an application, and was told to come back the next day at ten o'clock to pick up my license. This one was "duck soup." The next day I picked up the license and my call sign was 3A2BW. This, incidentally, was the easiest place in all my travels to get a license.

Up on the roof I went and in a very short time I was on my first DX'pedition tryout! Back then 3A2 was still on the relatively rare list and I wish I could tell you the thrill of being the chased, instead of the chaser. After getting on the air I had a chance to try out all the many ideas I had had for all these years as to how to operate a DX'pedition the right way. In many ways my ideas were good and some of them I found were no good at all. For one real surprise I had never given much thought to how bad European T-7 QRM could be, the many lids that kept calling on my own frequency, the UA boys insisting on giving me their name and telling me their power was 200 watts (most seemed to be named Vlad at that time). And what stopped me was they all insisted on my giving them my name, power, QTH, etc.

At Monaco I took out my little hand compass to see how the lay of the land was in the direction of the USA. I found that the highest mountain, the one that was the closest to me, was in the exact middle of the path. If ever I go back to Monaco I want to try my very best to operate from that neck of land that protrudes into the Mediterranean Sea, which would give a very fine signal path to everyone in ALL directions. The prices, the food, and the service at the Hotel Le Siecle are very nice, but for a good DX'pedition it's no good until someone removes that great big mountain. When you can't move the mountain YOU move!

Departure time arrived; we packed up everything and boarded the train that was taking us to Milan (on our way to Campione d'Italia, INSIDE Switzerland. I thought maybe a new country, but it wasn't). Well, this train stopped when it arrived at the Italian-French border and the fun began. If you want to cause a lot of excitement, try going into Italy with two suitcases full of radio gear, one of the pieces being a transmitter with markings for key, mike, antenna, etc., very plainly marked on the front panel. I had put a deposit with the French customs upon my arrival in France; at the border check point they had given me back this deposit and I had walked through a little gate that separated France from Italy. Now the Italians upon finding me with this equipment said that I couldn't bring it into Italy without an import license and to carry it back through the gate into France. Back I went with my suitcases. Then French customs said, "You can't bring that to France without an import license!" Well back and forth I went any number of times. Finally I just put my suitcases down in the exact middle of that door. Neither of them seemed to like this, but it's a sort of no man's land and they could not do anything about it. BOY, I WAS LEARNING, I sure was! The biggest fly in the DX'pedition ointment is ALWAYS customs. I

wonder if that small neutral zone between France and Italy would count as a new one.

Well after about a six hour delay and many phone calls to Rome we were permitted to bring our equipment through, but a deposit of something like $169.00 was required (this was sometime in late 1959 AND TO THIS DAY Italian customs still has that deposit of mine!). But we (Valdo I1IN and I) were on our way to Campione d'Italia IC1IN was the call sign issued to us.

The train was one of those coal burners and with all the tunnels in northern Italy, it's a wonder we all were not stifled to death; some of these tunnels are quite long and the trains always go very slowly through them. Sometimes they would stop for maybe five minutes right in the middle, and you thought you would sure enough stifle with all that smoke from the engine. My lasting impressions of northern Italy, and in fact nearly all the rest of Italy are: there are lots of very small villages; each one, even though it looks very drab and about to shrivel up and disappear, has a great big Catholic church; there are Catholic priests everywhere. Grape arbors! Oh, yes, they have them by the hundreds of acres, all over the place. All for making that Italian vino. Italian women like to talk and talk especially on the trains; it's always a talking marathon on these trains with these ladies. Everyone drinks their vino; sometimes a big bottle is all gone with a meal. I thought for sure that every place would serve spaghetti with nearly every meal, but do you know, I had a hard time finding a good spaghetti dinner in all of Italy. Just like I had a hard time finding sauerkraut when in Germany.

While walking down the street in Milan, right in the middle of the city on top of its highest building (I guess it was about twelve stories) I saw the doggondest thing—a five or six element 20 meter beam up on top of a 70 foot tower. Brother, this fellow had himself a real site for his beam. I asked Valdo who lived there and he said Bruno I1RIF. Later on—about three years later on—I visited Bruno and will tell you all in a later chapter of one of the world's best ham stations.

After spending one night in Milan, off we were for ICI-land by bus. At the Swiss border there were those customs fellows again. But upon producing our license for Campione d'Italia we were permitted to pass through without any difficulty at all except a deposit, which they gave back when we left.

Upon arriving in Campione d'Italia we found our little hotel—the only one in town—with one of those impossible roofs. So we ended up with just about the worst antenna that I have ever tried to use. The hotel room we had was on the third floor. The 20 meter dipole was a length of antenna wire from one window around the corner to the other. It was a dipole with a 90 degree bend in its center; the SWR was about five or six to one. It did load up kind of half-way. I tuned up the rig and said to Valdo, "Well, here I go with my first CQ with the world's first IC1 call sign." Valdo had already secured the license well in advance of our arrival but then he said, "No, no, we cannot go on the air yet. There are a number of things we must do first."

Our first call was at the office of the Governor, and after explaining to him the purpose of our visit and getting his approval, we went to the Police Chief's office for more explaining. We were told not to go on the air until the police came by and inspected our equipment. We then went to the Post Office and saw the Postmaster and did more talking, and he said OK. This took over half a day. We arrived back at the hotel about 2 p.m. and finished a very slow meal. We then went back to our room and had a short nap and fiinally about 4 or 5 p.m. three policemen came around to "inspect" our equipment and to also inspect us! These fellows knew absolutely nothing about radio; a radio amateur—ha, ha—they didn't even have the faintest idea what these words meant. So Valdo tried explaining what a ham was, and after about 30 minutes of fast Italian they departed. I said, "Is everything OK now, Valdo?" He said, "Yes, all is OK; we can now operate."

The results of this operation were not very good, mostly I think because of the antenna system. Also, to every QSO we had to explain where we were, and tell them that it would not count as a new one. All of this took a lot of time; then sometimes Valdo had to call CO Rome and this took up some more time. The European QRM was fierce from this spot. The QSO's with the USA as far as I can remember were few.

We stayed there about seven days and away we went to San Marino. Valdo had been issued the call sign of I1IN/M1 and I had W4BPD/M1. The trip from Milan to San Marino was made by train again—all those smoky tunnels again. We arrived at a small sea port town, and then we boarded a bus to San Marino, some 35 miles away.

San Marino, as far as I remember, is just one whole mountain; it covers the mountain from its base to its top. It's strictly a tourist spot. When we arrived there I saw about a hundred big buses, about the size of our

Greyhounds, all from Germany. Tourists were all over the place snapping pictures, and every little shop was full of them. It sort of reminded me of Asheville, North Carolina, in the middle of summer with the tourists there.

We checked with the police again and got their approval. But up to this point we had not selected our QTH! They told us when we got located to come back and let them know where we were going to be operating from. We wandered around to a few hotels, all of them quite steep in rates and not too well located to suit us. Then I suggested to Valdo that we try to get permission to operate from the high watch tower that overlooks all of San Marino. He said that he thought this was not possible but we could try anyhow. So away we went.

To get to the top required walking up 880 steps (I counted them myself!). We found a very nice guard named Joe in the old castle that's under the high watch tower and after a good long talk he went to his boss and it was decided that it was OK with him for us to use the small room right at the very peak of the tower. This is the very highest spot in all of San Marino; it's about 100 feet or more high and on top of that it's on the peak of the mountain—it's even a better QTH than W3CRA has! So up the steps we lugged everything and we strung out our string of dipoles in tandem: 10 meters, 15 meters, 20 meters and 80 meters, all between the two tower peaks. We had a real antenna system. With the assistance of Joe, our guard friend, we got 230 volts up to our room.

After everything was installed we went back to the police chief to check in with him. Then we went up the 880 steps to our shack and away we went with our first CQ. The results here were fantastic; we got the best reports and really had a ball. Joe brought us up two Army cots to sleep on and even a small electric heater and a few blankets, and on top of that a big plate of spaghetti that his wife had cooked for us, and boy she really knew how to cook REAL Italian spaghetti (the kind that is so hard to find in Italy.) After staying there a few days and walking up and down those 880 steps, which was killing me, I asked Joe if I could pay his wife to cook us a big plate of that good spaghetti every night for our dinner. This she did, thereby saving us many steps up and down. Occasionally we would go down to have a meal at night and let me tell you, it is spooky walking through a number of rooms in an old castle with the walls covered with instruments of torture, old guns, coats of

armor and many other relics of ages long past, and only a flashlight to see where you are stepping.

Every night at about 11 p.m. it started to rain and this continued every night we were there. Lots of wind blew all the time, day and night, and lots of weird sounds were heard with this wind blowing through the old castle. One night, just as one of these rain showers started, the most awful noise started coming out of the phones. It kept building up and up, and finally the S meter was reading S-9 plus plus plus! All signals were blotted out, of course. I turned off the set and, believe it or not, the noise was still heard! I started hunting for the source and when the light was turned out I saw a very thin blue halo on the end of each of the unused antennas. I reached over to ground one of them, but it reached for me first and what a jolt I got! When I had grounded the center conductors of each of the unused antennas I then observed that the outside shield was still arcing from every unused antenna to the concrete wall. After grounding every unused antenna and its shield, all the noise disappeared from the 14 mc antenna and back I was on the air.

One night the wind was almost at cyclone force, but I kept on operating anyway. I noticed the SWR went up a little higher than usual in the middle of this storm, about 10 p.m., but I operated on until about 2:30 a.m. anyway and went to bed. The next morning I went outside to look over the antennas to try to see if I could find out why the SWR had gone up. I found that the whole string of antennas had fallen and was strung out down the mountain side, lying right on the surface of the mountain. Except for the slightly higher than usual SWR I could not see that there was any noticeable effect on getting out.

Many amusing things happened while we were there. All day long tourists came and went, walking around the little stairway around our little shack. After the first day we decided to keep our door closed to eliminate them QRM'ing us with a lot of questions. Sometimes when they were outside and saw the closed door one of them would say something like, "I bet if this old tower could talk it could tell some interesting stories about people being killed in these rooms." That's when Valdo or I would let out a blood curdling yell or a good loud groan and hit on the door with a shoe. Then you should have seen them scram back down the spiral stairs leading away from the spooks in the Belfry Tower! This happened any number of times every day and was a good pastime for us.

The operating at San Marino was very good and Valdo and I departed for Rome with a very satisfied feeling. The trip to Rome, as usual, was made by train and they were jammed full as is usual there. We went third class to save our money and we arrived the same time the first class arrived. We went directly to the Vatican and met Dominico HV1CN. I asked him to let me operate HV1CN for a few days, just on CW. There was a lot of hesitation and a few questions, including what was my religion. I guess when I said Baptist I must have given the wrong answer or maybe it was something else. But anyway, he did finally say, "OK, you can operate some on CW." After getting the keyer out of the drawer and blowing the dust off (the mike was nice and clean) I plugged her in and while Dominico was telling me to give only signal reports and under no circumstances to give my name, I let loose with a fast CQ on 15 meters and boy, the old dead band really opened up. In nine minutes I had 11 QSO's, all Europeans. While I was writing down the call sign of the next caller, Dominico reached over and pulled out the power plug and said, "Well, it's time for lunch." I asked him if I could come back after lunch and do some more operating and he said, "I will get in touch with you." That was the end of my HV1CN operation. I can at least say that there has been one Baptist who has operated HV1CN, even though it was for only nine minutes.

On over to Yugoslavia with a brief stop at Zagreb and on to Belgrade and a one week's stay with YU1KC and his son YU1EH, where I was treated royally. A fine place, Belgrade, and fine people these Yugoslavs. Some day I want to return and get to know them a lot better.

Off to Athens where I was met at the airport by SV1AB and SV1AE, good old George and Sock. I spent about a week with George in his home, was taken all over Athens and saw all the historic sights. George doesn't have coffee for breakfast—it's a cup of good HOT milk along with his breakfast each day. I did not think it was possible for me to take this, but I did and it stayed down, so sometimes you fellows try a cup of hot milk for breakfast and you will see what I mean. It will not kill you, but—well, try it!

That's all for this time—next month it's ole Rundy OD5CT, Cairo, Khartoum, and Kenya. Then off to the Seychelles and octopuses, Lee Bergren WØAIW, some /MM and ole Harvy Brain. Stick with me, boys, there's a lot to tell yet!

. . . Gus

Paul Franson WA1CCH

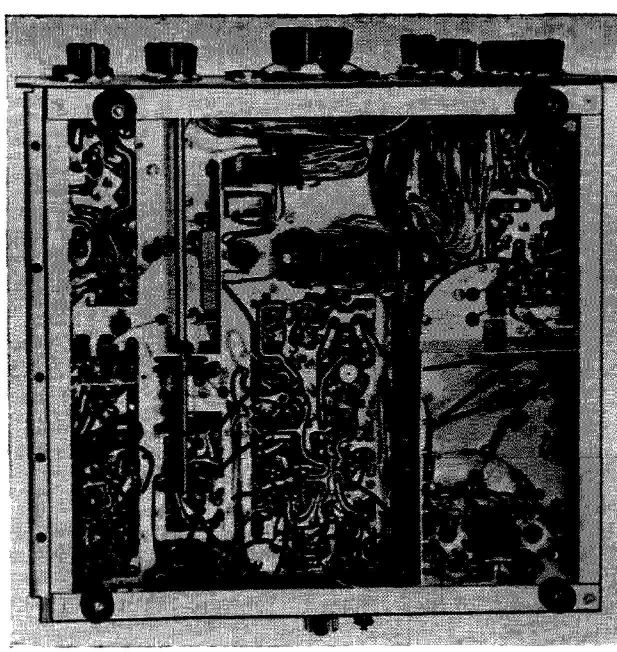
A 6 meter transceiver for the fine Heath SB-Line

73 Tests the Heath SB-110

Has 6 meter sideband arrived? Yes, it has. Anyone with interest in the band—and anyone who listens to it—can't help noticing that the gentle quack-quack is becoming more and more prominent. Half a dozen firms are making 6 meter SSB transmitters and transceivers now, and more are expected very soon. The reasons for this growth are obvious. The Technician license class now contains the second largest number of hams. Most of the active Techs are on six, making it one of the most popular ragchewing and mobile bands. As the band becomes more heavily populated, interest grows in better equipment to make more satisfactory contacts possible and the increased activity makes manufacturing SSB—and transceive operation—have proved themselves overwhelmingly on the major HF bands. Now Heath has provided excellent SSB equipment for 6 in kit form.

The Heath SSB-110 is a mighty attractive piece of gear. It matches the other members of the well-proven Heath SB line in appearance and performance. Briefly, it offers: exceptional receiver sensitivity, stability, selectivity and resistance to overload with an excellent ALC controlled SSB-CW transmitter which delivers about 100 watts PEP with minimum distortion and unwanted mixing products. Both the receiver and transmitter sections are well designed, solidly and reliably built (If you follow Heath's excellent instructions) and convenient to use.

The SSB-110 arrived in a large box one morning. Since I am the most curious person since Lot, I immediately opened it up. Ignoring Heath's instructions to check the parts list carefully (I should have. Nothing was missing, but there were these two dial pulleys, one with a 1/4 inch shaft and the other with 9/32 . . .) I noted the incredible number of parts. All were of excellent quality. No junk, of course. The most sobering part of the quick



snoop was the bag after bag of solder I uncovered which made the job look fearsome, so I stuffed all that I could back in the box (how do they get it all in there?) and went back to work.

That night I attacked the construction. I won't claim that it was a two hour job, but it wasn't hard or unpleasant. Most of the parts went on five printed circuit boards and the whole assembly was so well-planned that there wasn't a hitch in construction. They even have things figured out so that the procedure is self checking. I found my little stupidities very quickly so that the final check disclosed no uncorrected errors. There weren't any real tight spots either, though wiring the relay with 18 contacts was rather challenging. Heath furnished two wiring cables that took some of the fun out of the construction—thank goodness.

All in all, it took about 35 hours of evenings and weekends to build. I have built quite a few kits, and suspect that someone with less experience would take a little longer (and probably do a neater job). Incidentally, even a rank beginner could probably do a good job on the construction if he followed instructions carefully and took his time.

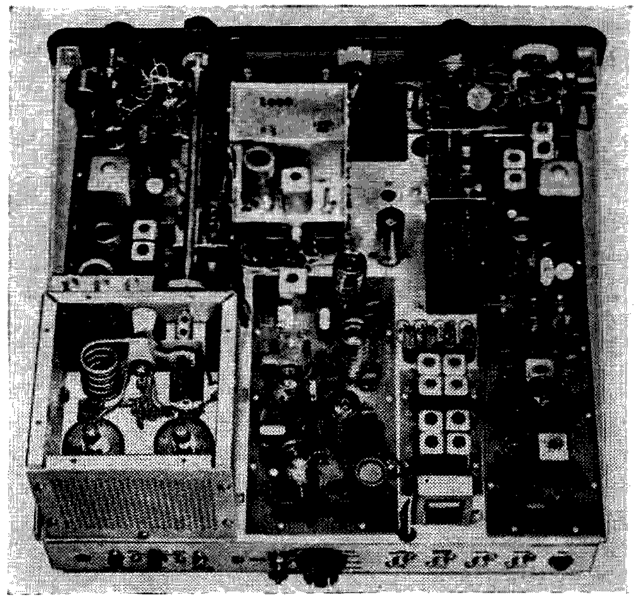
When the assembly was finished, I checked the recommended resistances to make sure that the first test wouldn't be the last. Everything was fine, so I built the matching HP-23 supply. It took about an hour and a half.

It didn't blow up. In fact it couldn't since a few vital resistors weren't connected until later. It just made a pleasant receiver noise. Next I aligned and tested everything. Here again, the instructions are completely lucid and foolproof, but not assistant-editor proof. I didn't read the instructions properly at a few places and had to backtrack. You need a VTVM, dummy load (like a Heath Cantenna) and a receiver that will tune WWV (or even a BC station on a multiple of 100 kc) for the alignment. Heath furnishes the alignment tools.

My home location couldn't be worse if it were underground, so I drove up to Wayne's place on Mt. Monadnock (known as 73 Mountain to some) to connect the transceiver to a good antenna.

To tell you the truth, it didn't work too well at first, I couldn't hear a single station. But things improved remarkably after some slight adjustments . . . like connecting it to the antenna instead of a dead end cable going behind the bed.

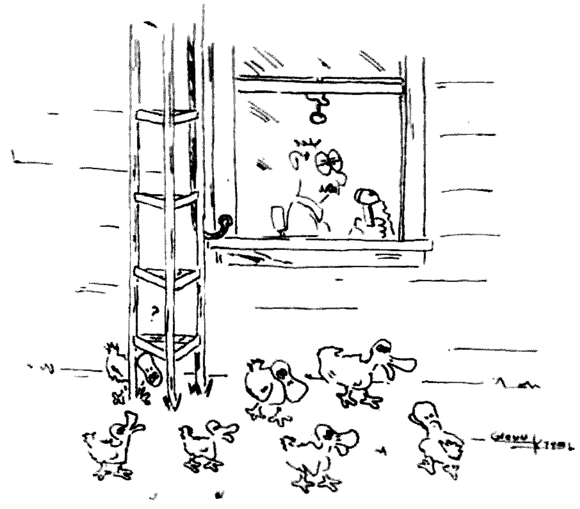
Performance was outstanding. I compared the receiver to a couple of well known 6 me-



ter transceivers and it beat them flat. The tuning is soooo smooth and slow. It really dug out the weak ones while ignoring the FM station that usually comes in so well on 6 up there. I tuned around a bit and decided that the maiden contact would have to be with an SSB station in Connecticut, about 150 miles away. He came back instantly and reported everything was fine. In fact, he was using an SB-110, too, and I can verify that it puts out a fine signal. Closer stations also said that the signal was perfect. I think that Heath has done an excellent job on this transceiver. I suspect we're going to be hearing lots of them on the air.

. . . WA1CCH

PS. About that solder, I only used a small part of it. Turned out the job wasn't so bad after all . . .



QRZ . . . QRZ . . . QRZ the sideband station . . . you're all over the band, OM. Copy you all over the band . . . QRZ . . . QRZ . . .

Howard S. Pyle "YB" of W7OE
3434-74th Ave. S.E.
Mercer Island, Wash.

Are You Really a Technician?

Maybe your license says you are, but *are* you? Certainly you are legally recognized as such as attested by your ticket. Are you actually performing in that capacity however?

The Technician class license was established by the FCC with the primary purpose of encouraging amateur experimental and development work among those hams with little interest in other phases of amateur activity such as all-band, two-way communication, participation in code speed and the myriad other types of contests, DX contacts and many more such diversified interests. Experimental work by the bona-fide Technician class however, has produced some interesting developments. Fortunately, there are a reasonable number of serious-minded Technicians who accept the privileges permitted by their license, as a responsibility toward advancement of the art. They have no particular interest in amateur *communication* as such, although the FCC has provided them with a few limited communication channels. With these, they can communicate with other experimenters in their relatively local areas for the purpose of an exchange of ideas in connection with their work. Such channels however, all too often become simply amateur "rag-chewing routes" by the non-experimenters and much of the communication is entirely contrary to the intent of the Technician classification. "Round table nets" are often formed by this class for the express purpose of general "chit-chat" on channels assigned primarily for experimental purposes. Most of this casual conversation is entirely foreign to technical experimentation and development. Such use is most certainly completely unfair to the conscientious Technician licensee as it often deprives him of the few communication channels allotted to him through which to exchange technical information and ideas. It therefore represents a most selfish view-point on the part of those "lazy" amateurs who take advantage of the Technician communication channels for general amateur communication. We say "lazy" because such action on their part is a pretty direct indication that they do not care to put in the time and effort to master the radio telegraph code to the extent of 13 words per minute. If they would do so, *all* of the privileges open to United States amateurs would be theirs. This would include all of the Technician class assignments as well when they desire to use them for *experimental* purposes. For the ham who qualifies for a General class license, there is no need to use the Technician class frequencies for other than purely experimental work and communications pertinent thereto; he has so many other bands which he may use for general amateur communication.

In the technical development field, amateurs have always been almost awesomely predominant and have pioneered the way for a great deal of commercial development. Is it right that we should narrow such experimental activities by creating interference, often of a most aggravating type, to the technically-minded experimenter who is exerting most of his effort to development and improvement of the art of Hertzian wave propagation?

Certainly we recognize the fact that in addition to the 13 wpm code speed requirement there are a couple of other considerations which enter into choice of a Technician class license rather than that of a higher grade, even though the applicant has no particular leaning nor desire to contribute to the advancement of the art through experimentation. First, to repeat ourselves, is this "lazy" attitude toward acquiring the code speed for a higher grade license? Why shy away from that, however? No doubt you put in many more hours in your study of math, general

science, physics, history etc. in your school years in order to attain a passing grade. It may take a small child two or three years to begin to recognize and understand the simple phrases tossed his way by adults: "Ah, ah . . . mustn't do that" . . . "Baby, stop that", "No, no . . ." etc. Likewise, before he can pronounce simple words in a decipherable form such as, "Daddy" . . . "Mommy" . . . "Kitty" . . . etc., he goes through many months of learning this simple oral vocabulary.

As a Technician licensee, if such license is what you have decided to apply for, assuming though that you want to be an all-around amateur rather than an experimenter, but because the 13 wpm code speed scares you off, do you know that it will take you far less time to attain this speed than it takes a baby to learn to walk from creeping? To use a common expression, you're "chicken" if you don't dig in and concentrate on getting your code speed up to the required 13 wpm which will enable you to by-pass the Technician grade if it is general amateur communication which you want. The FCC is most generous in allowing you a year as a Novice in which to build up the meager additional 8 wpm code speed required for the General class license. Assuming that you have average intelligence and a reasonable amount of spare time for Novice operation on the air, you can accomplish this in a period of only two or three months. Naturally, you must increase your knowledge of radio principles by study of the 'theoretical' aspects of radio communication as well, for your examination for a higher grade license than Novice, be it Technician or General, will require that you answer correctly, approximately 74% of the 50 questions with which you will be presented in the written examination for either the Technician or General class license examination.

So . . . what are you faced with in choosing between applying for a Technician or a General class license examination after your period of 'apprenticeship' as a Novice? The written or so-called 'theoretical' examination is the same; the only differentials are that for the Technician class you do not have to increase your code ability beyond the five words per minute required for a novice examination but you *do* have to demonstrate, through written examination, that you have much more familiarity with the equipment which makes radio communication 'tick' than you had to do in your Novice examination. In fact, you are going to have to pass a written examination in this latter subject which is the equivalent (and

practically almost identical) with what you will face when you apply for a General.

If you are interested mainly in the experimental aspects of amateur radio and would like to put your "two-bits' worth" into experimental and development work along these lines, then you should rightly apply for the Technician grade of license. On the other hand, if you are interested in the broad field of amateur two-way communication with little emphasis on the experimental angles, you belong in the General classification. With the examination in written form being practically identical for either the Technician or General class license, your only problem is the differential in code speed required. Again that puts it strictly up to you; as a prospective Technician licensee you have no real reason to acquire a 13 wpm code speed ability, if the sole purpose in applying for a Technician class license is for *experimental* reasons. Most of your communication with other experimenters in the limited frequency bands assigned you, will probably be by radio *telephone* anyway. The code speed requirement of 5 wpm for this class of license happens to be a Federal requirement and you are going to have to meet it, whether you use the radio telegraph code or not. On the other hand, if you plan to apply for a Technician class of license with the major purpose of using it for rag-chewing and other types of, shall we say, "social" communication, this immediately places you in the "lazy" class of ham; you should take a little more time and devote a few more hours of study so that you can make the grade as a General class amateur!

Another consideration enters the picture here. As we all know, the Novice class license is good for only one year, cannot be renewed and can never again be issued to you. So, if you don't qualify for the Technician or General class within that year, you are out on a limb. Sure, you can take the higher grade examinations at any future time if you wish and, should you fail, come back in 30 days and try again . . . repeatedly. Once you are successful in passing the examination for either class, you are issued a license which *is* renewable every five years, for your lifetime, without examination of any kind, including code, if your application for such renewal is filed *before* expiration of your current license.

In addition to the renewal privilege which both the Technician and General class licenses provide, we have another factor to consider and which we might term the 'personal pride' angle. Once a Novice class licensee has passed his examination and been issued formal Federal call letters, he looks on them with pride; they are his identification in the realm of hamdom. The Novice looks forward eagerly to the day when he can drop the 'N' from his call by reason of acquiring a higher grade license. His call letters become his 'nick-name'; J. P. Morgan, of Wall Street brokerage fame was most frequently referred to as "J. P." and he liked it. Your neighbor James, much prefers to be called "Jim"; Robert, down the street, glories in the nickname of "Bob". Even this author much prefers to be referred to and addressed by "YB" rather than his given name.

That introduces an additional reason for applying for a Technician class license after the Novice period. To carry on the initial call letters (dropping the 'N' after the Novice year) has become practically traditional. When the eleventh month after receiving his Novice license rolls around, the embryo amateur who feels that he cannot qualify in the 13 wpm code requirement, becomes a bit panicky in that he feels that if he cannot pass the General class code examination, he will probably lose his call and thereby the identity which he has attempted to establish in his year as a novice. So, with the code speed requirement for Technician being only that which he has already acquired (5 wpm) he elects to become a "Technician" with the five year renewal privilege and retention of his present call letters, minus the 'N' which stamped him as a novice.

Is this fair . . . is it right? With an entire year in which to qualify for a code speed of 13 wpm if he wants to be a full-fledged radio amateur with *all* privileges, doesn't his lazy streak stand forth glaringly?

None of the foregoing has been intended in the least as a tirade against the bona-fide, non-communication minded *experimenter* who is really seriously interested in contributing his bit to the progress of the art. Our hats are off to them; they have actually been and still are, the backbone of ham radio. We *do* though, say "shame" to the 'lazy' ham who wants to carry on casual two-way communication using the Technician frequency assignments to avoid increasing his code speed, just because such use, unfortunately, happens to be legal, although frowned upon. He is definitely handicapping the legitimate, Technician licensed experimenter who recognizes his obligation to the art and to his fellow hams. If you have been, or currently are using the Technician frequencies for casual, social interchange, think it over! . . . W7OE

73 Reviews

the Transcom SBT-3 Transceiver

The newest entry in the sideband transceiver market is a tiny little unit put out by Transcom Electronics in California. This is the smallest and lightest transceiver ever made, weighing in at 11½ lbs and being 4½" high, 11½" wide, and 9" deep. The clever design of this unit uses transistors in all but the final stage (8042's) which is instant heating. Thus on receive the whole transceiver only draws a half ampere. On transmit it draws 12-15 amps for 160 watts PEP input.

The Transcom is particularly designed for mobile operation. It covers the 20-40-80 meter phone bands only, and with generous bandspread . . . calibration every 5 kc. Most of the controls are knurled knobs which take up little panel space and can be operated by one finger.

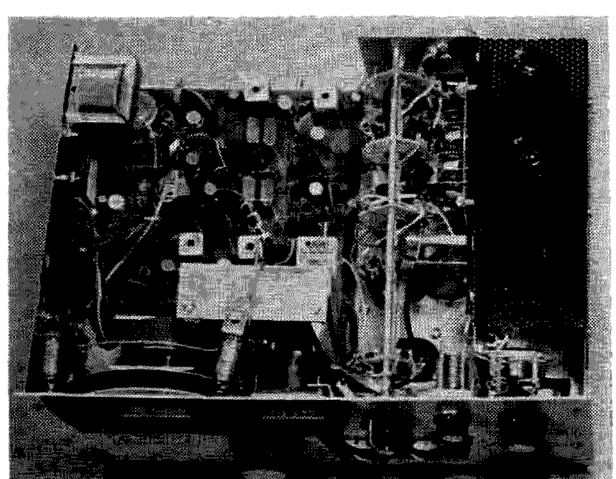
The dc power supply is surprisingly small, weighing under 3½ lbs. This certainly could be fitted into the most crowded engine compartments or up under the dash.

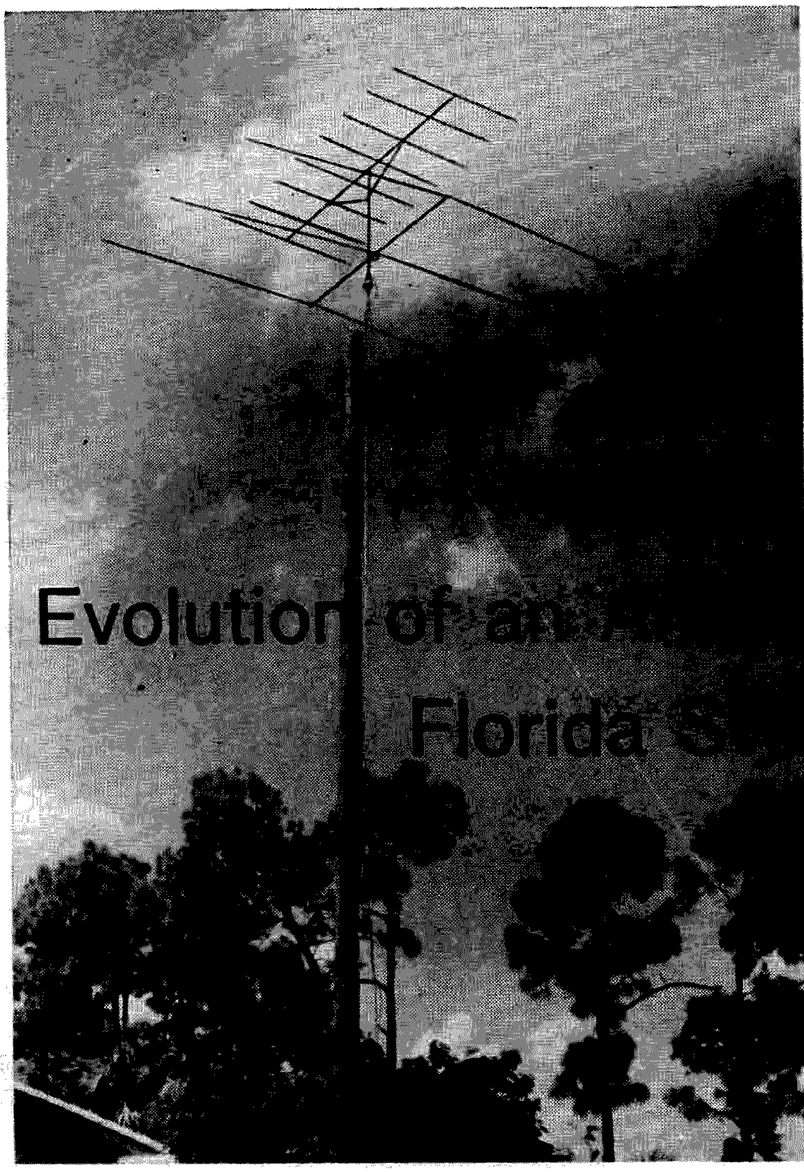
In use barefoot with a three element twenty meter beam the rig brought in good S-9 reports from all over the States and plaudits from Europe and South America. Signal reports were universally complimentary and the receiver seemed to really pull them through with no difficulty. Drift was not noticeable.

In a short test period in late September we called a short CQ, got called by K4IKR in Alabama, who happened to be reading the two page ad for the Transcom in the latest 73 at the time of the contact. 30 over 9 was the report. Not bad for 100 watts PEP output. Next I called HB9ADD and got an S-9. Then DL4UV in Karlsruhe called me to tell me I was 10 over there and then OZ4AZ reported it 5-8 up in Copenhagen. G3OCB had a nice report from London to my CQDX, followed by an S-9 from DJ8EG up near Kassel. And that's the way it went.

Transcom has designed a nice unit and I suspect that we will be seeing a lot more transceivers using this principle of transistorization with instant heating final tubes. It certainly is most efficient for mobile operation.

. . . W2NSD





Earl Spencer K4FQU
1413 Davis Dr.
Ft. Myers, Fla.

Evolution of an Antenna Tower — Florida Style

For years I've tried different types of antennna towers. My last was a good commercial job, quite satisfactory in performance, but only 35 feet high. Most amateurs may figure that this is high enough, but there are a few of us that are not satisfied unless we sport the highest beam in the country.

I had been on the lookout for a used telephone pole for a long time, but none seemed to be available over 35 feet high. In final desperation I approached the higher ups in the local power company and they finally located what I wanted lying in an obscure corner of their yard, marked "Out of Service". This meant that it could no longer be used as a transmission pole, but was still sound and would serve my needs. The pole was a Class "A" type transmission pole, 80 feet in length and over 30 inches thick at the base. I was overjoyed at the gift, in spite of the slight hitch that they could not deliver it due to an insurance problem. I figured that it would be a small matter to get it home.

After two weeks of trying, the pole was unmoved. I just couldn't find anything capable of transporting it through the city and was pretty discouraged. It was frustrating to have a dream pole and not be able to get it the six miles to my home.

Then came a stroke of luck. While talking to a good friend who works for the telephone company, I mentioned my plight with the pole. When I told him how big it was, he changed the subject. I thought I was still batting zero until I almost ran over it that night in front of my house. The telephone company had picked it up at the yard and delivered it free of charge. How they ever carried it with their small rigs is still a mystery, but I am grateful, and won't ask questions.

Now all I had to do was get it in the ground.

How do you get an 80 foot pole, weighing many tons, twelve feet into the ground? I started getting estimates from various contractors that do this kind of work, but the cheapest price I could come up with was $50. I later decided that the price was not as bad as it sounded, and in fact would have been a bargain.

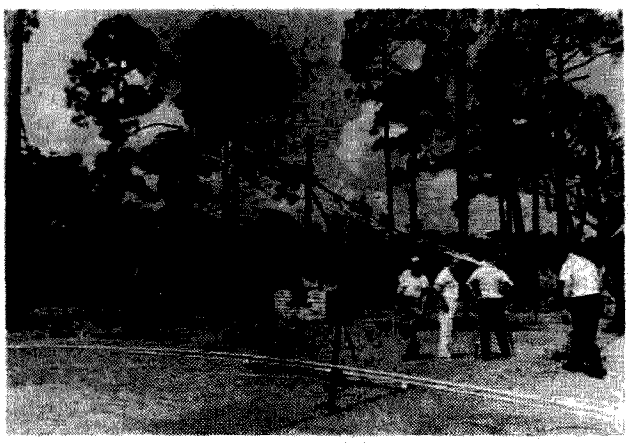
I decided that I would set the pole myself to save the money. I borrowed a small drag line with a 30 foot boom from a friend. All I had to do was dig the hole. I let him talk me into it, as the price was right up my alley: nothing. Before I had finished digging the hole, I wished I had hired someone to do it.

The power company recommended that the pole sink 12 feet in the ground. I started to dig. At four feet I hit water. Three more feet down, the water started giving me trouble. When as much dirt fell back in the hole as I pulled out, I figured it was time to go for help again.

I had dug this far with a shovel and a four foot post hole digger, which meant that I was reaching into the hole better than two feet. I conned the power company into loaning me a ten foot post hole digger, and it took me a week to dig the hole, working nights after work.

Saturday and the crane arrived at the same time. The crane could barely lift the pole enough to drag it the 150 feet from the street to the hole. It hooked the pole just high of center balance and started to lift it into the air with the base end hanging over the hole. The base started to slide, and dropped into the hole on the first try, splashing 8 feet of muddy water all over. The crane boom caught the pole short when it hit bottom and held it upright. We jockeyed it around until it looked plumb. The crane boom was locked in place and left for the weekend while I filled the hole. The entire operation was the most nervous hour I ever put in.

My wife decided that it looked too unstable, and convinced me that she was right. I headed for the hardware store on the double. My first expense for the pole came to $28. I used 300 feet of ⅜ inch galvanized steel cable for the guys, along with 30 cable clamps, 3½ inch by 14 inch turnbuckles, and 3½ inch by 12 inch eye bolts. The pole was guyed at the two thirds level and it was secured by wrapping the cable around the pole and fastening with two cable clamps spaced two feet apart on each cable. To keep the cables from sliding down the pole, I drove a ½ inch by 8 inch lag bolt into the pole on three sides and left one



Typical seedy Ft. Myers hams chasing an alligator before the antenna goes up.

inch sticking out of the pole. The cable rests over these three lag bolts and prevents it from sliding down the pole. The guys are anchored by driving a 12 foot pipe into the ground at an angle running back towards the base of the pole with a foot left above ground. The guy wire is fastened to this pipe by a turnbuckle and an eye clamp. The guy was propped by a four by four directly in front of the pipe 5 feet off the ground. Down through the top of the four by four I drove a large eye bolt and ran the guy through it to keep it from slipping off the post. This prevented people from tripping or hanging themselves on the guy wire. The guys are broken up by a large insulator which was scrounged from the power company. We did not pull the cables tight, but left a couple of inches of sag in them.

The pole stood for a little over a year without an antenna. It took me that long to gather up the ideas and the parts to finish the tower.

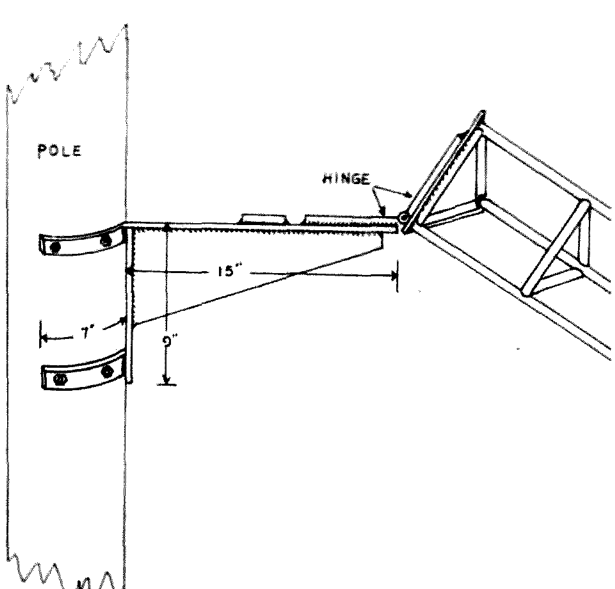


Fig. 1 Base plate assembly. All 3/8 steel plate, electric arc welded.

The tower consists of two different sections of an E-Z Way crank up tower. The bottom "Donna." We got them for nothing from various radio and TV repair shops. The sections were in slight need of repair, which I managed to have done by the time they were needed. They were stripped, cleaned thoroughly with an electric wire brush, and painted with aluminum paint.

The top section is the five inch inner section of an E-Z Way crank up tower. The bottom section is part of an eight inch tower, make unknown. The two sections were welded together. Note the offset in the tower due to the two different sizes of the tower. The top section rests on a steel plate welded to the first rungs of the bottom section. The bottom of the tower was then welded to a piece of ½ inch by 8 inch by 8 inch steel plate and one leaf of a 4 inch steel door hinge was welded to the bottom of this plate. The other leaf of the hinge was welded to the base plate assembly (see **Fig. 1**) which a welding shop made to my drawings for a price of $12.00. We cleaned it and painted it with aluminum.

We started to raise the tower by installing the permanent gin pole at the top of the telephone pole. The gin pole itself is a 48 inch length of ¼ by 2 inch by 2 inch angle iron to which the hook of the gin pulley is welded at the top inside apex of the angle formed by the V. The pulley hook is welded with a slight downward angle so that the pressure will be pulling straight at the pulley when the tower is down. The gin pole is bolted to the backside of the pole with 3½ by 4 inch lag bolts and extends about 12 inches above the top of the pole so that the pulley is centered over the top of the pole. Next we ran ⅜ inch galvanized cable through the pulley and down the inside of the gin pole, passing the lag bolts to one side, and on down to the ground. The other half of the cable went to the ground on the front side of the pole. See **Fig. 3.** This cable was then fastened to the top section of the tower immediately below the rotor with a pair of cable clamps. The base plate assembly was installed to the bottom of the lower section of tower by mating the two leaves of the door hinge.

We pulled the entire tower assembly in an upright position against the pole. It took two men pulling on the gin cable to hoist the tower to the top of the pole. We anchored the tower to the pole temporarily while we fastened the base plate assembly to the pole. 2½ by 6 inch lag bolts were used in each strap to hold the base plate to the pole. Then we let the tower drop over until the rotor was accessible from

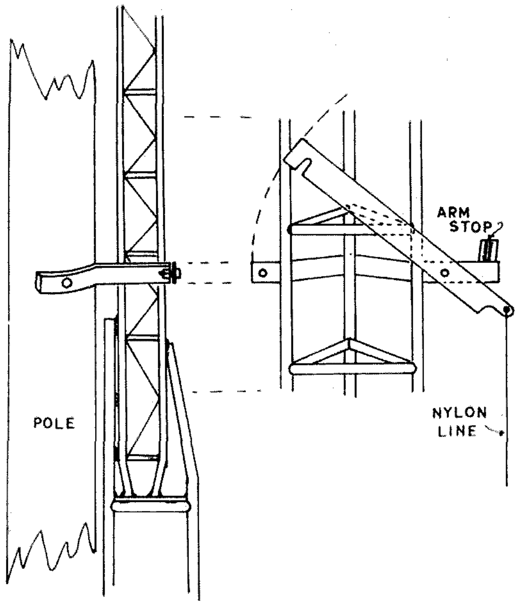


Fig. 2 Center support detail.

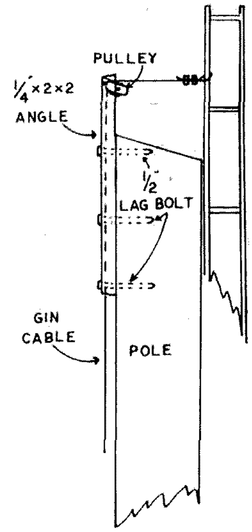


Fig. 3 Gin pole detail.

the ground. We tested the tower a few times to be sure it worked and then proceeded to install the antennas.

The length of the boom on the tri-bander made it impossible to stand on the ground to work, so we had to prop the tower up until the boom cleared the ground. I wound up driving my truck under the rotor and working from its roof. I realized that this would happen every time I let the tower down. In the future, I shall use a heavy piece of aluminum pipe 12 feet long, capable of supporting the weight. This will be attached to the tower just below the rotator with a small hinge which will allow it to hang free alongside the tower. When the tower is let down, gravity will pull the leg out and it will hit ground first, holding the antennas off the ground.

When the coax and rotor cable had been attached to the antenna, we fastened the center guide support to the tower, which has a small rope tied to the right handle of the front bar. See **Fig. 2.** Note the arm stop above and to the right of the front arm. This stops the arm from flopping over and allows the center to remain open so the tower can be lowered. To operate, simply pull quickly on the rope and the arm will swing over and rest on the stop. To close the support arm, whip the rope slightly and the arm will fall and lock over the pin, using its own weight to hold it in place. Thus the tower is held rigid in three places: at the bottom by the base assembly, at the center by the guide support, and at the top by tension on the gin cable.

After checking over the entire rig, we were ready to raise the tower and its antennas. At this point I still had no winch, so we had to raise it by the armstrong method. It took the combined efforts of 4 men on the gin cable and 2 men pushing up on the tower at the rotor to start it on its way. When it was raised about one third of the way, we found that three men could handle it; and from the halfway point, one man finished the job.

We were worried about the tower bending in the middle due to its length and the small top section, but it went up without a trace of a bend except for the little that looked as though it should be there. To pull the tower into place, we ran the cable straight down the back of the pole and through a pulley about 3 feet off the ground and pulled parallel with the ground.

The permanent arrangement will use a double block assembly above the winch so that one person can raise and lower the tower easily. When the tower was halfway up, the sag had disappeared completely. The white line seen leading away from the tower serves to help guide it. When it was in place, the lead line was pulled tight and tied to a small boat cleat at the base of the pole.

Erecting the tower took about 7 hours and a case of 807's. The rotator was a CDR AR-22, but Ham-M or TR-44 would be better. The AR-22 drifts a lot, although it does a nice job of turning the array.

The top antenna is the Civil Defense beam, Hy-Gain 8 element 6 meter array. The bottom beam is a Hornet Tri-Bander, TB-500, somewhat modified from its original egg-beater condition of four years ago. The mast is a 10 foot piece of 2 inch steel pipe. The estimated weight of the array, including the rotor, is about 60 pounds; its total height is 83 feet. This installation has withstood winds in excess of 60 mph without budging. Total cost was about $50.

. . . K4FQU

Did you enjoy the articles in this 73?

Of course you did. So look at what we ran last November:

VHF Log Periodic
SSB VFO
Color the Grommet Gone
A Tuneable Antenna for 432
On the Air on 432
Precision Audio Attenuator
6 meter VFO Transmitter
Sterba Cartain for Two
Electrolytic Saver
KMW-2 Voltage Regulator
80-40 Vertical
Transistor AFSK
2 meter mobile
Mobile Phone Patcb (?)
KWM Operating Notes
SJS Part III
UHF Transistor Circuitry
6 meter QRP Station
Mobile Noise Limiter
Ham Operating, FCC Version
Designing Phase Shift Networks
The Easy Way
Failsafe Power Supply Control
Incremental Tuning of the NCX-3
SB-33 and MP-10
Return to the Art
Heath Applications Series
Kentucky DX'pedition

And November 1963:

Another Approach to TVI
Surplus 432 Converter
The Perfect Match
SWR/PWR Meters
All Band Conical Antennas
Tool and Workshop Section
AC Adaptor
Come-a-Longs
Of RTTY
73 Tests the SK-140K
The Amateur's Cape Canaveral
Listen Fellow Amateur
Communicator IV on CW
Premium Tubes
73 Tests the B and W 6100
The Battle of the Century
Shocking . . . but True
Slow Scan Vocoder Transmission

Interested? We still have a few copies of each available for 50¢ apiece. Why not order a few to keep you company these long wintry November nights?

And in fact, we have copies of most of our back issues around. All are 50¢ apiece except 1961 and June and November 1962. 1960 and January 1961 aren't available.

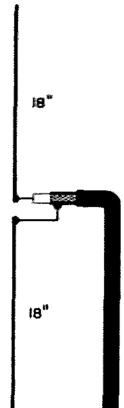
Or maybe you'd like our assortment of 20 different back issues of 73 for just $5. Much better than *Peyton Place*—and the editorials are just as scandalous.

73 Magazine

Peterborough, New Hampshire 03458

Maurice Lewton WA6PHR
1323 Via Del Carmel
Santa Maria, California

Two Meter Beacon



A remote signal beacon is very useful during alignment, antenna checks and other amateur testing. This simple low cost two meter beacon uses a cheap 8 mc crystal and very little else. It can be heard about half a mile away using 1 ma at 1.5 volts, or the input can be reduced for closer work.

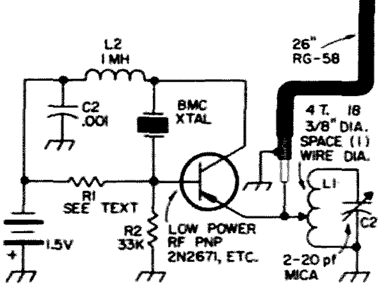
The entire unit can be built with one octal socket and a small terminal strip. The socket will hold the FT 243 crystal, the transistor can be placed in the hole and the unused terminals can be used as tie points. Make the RF leads short.

R1 will be from 50 k to 250 k depending on the transistor you use. Adjust R1 for 0.2 to 1 ma collector current. Most low leakage transistors that will oscillate above 8 mc will work. The emitter tap should be at ½ to ¼ turn above ground.

When you've finished building the beacon, monitor the collector current and pull out the crystal. If there is a change in current, the circuit is oscillating properly. Then look for the 18th harmonic of the crystal on two meters. It should be quite strong. Adjust C1 for maximum signal.

I even tried the beacon at 9 volts and 10 ma connected to my beam. I worked three stations on CW! But if operated at 1.5 volts with less than 0.3 ma, battery life should be virtually the shelf life.

. . . WA6PHR



Bill Hoisington K1CLL

A heterodyne-VFO storage-battery portable transmitter for six meters.

Slippery Six

Right off I would like to point out that I'm not in a war *against* Handbooks, far from it. They are my favorite literature. It's just that they seem to miss the boat on some important items for amateurs. So they want to "Swim with the crowd"; so, "what is it sold last year?", etc. No thanks. There are new things sometimes, improvements and new uses for older ideas. For example, the heterodyne vfo. As far as I know (may not be too far) there have not been many articles on this item for the amateur. In the military, yes. I first met this system soon after the war, using "quad diodes" for mixers.

There seems to be a wide gulf, much too wide, between the Military (Government) and amateur requirements. This doesn't really have to exist at all. The gulf, I mean. It just needs someone to "translate down" a little. Granted, amateurs do not need 100 G vibration tests, 300 C temperature tests (will that fry eggs good?), and 5 different kinds of fungus bugs (available in stock numbers from the U. S. Navy) for mildew tests. But certain basic principles and circuits that are good for the military can be used to advantage by the amateur. The heterodyne vfo is one of these.

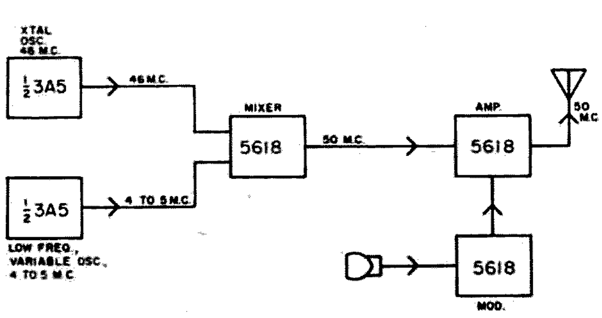


Fig. 1. Block diagrams of heterodyne rig.

Plenty of real good engineers who have been working for the government know about this. A lot of them are amateurs too, friends of yours, friends of mine, on the air, etc. But their daily stress of work sometimes impedes their possible translation of new items into amateur rigs. This one, the heterodyne vfo can be particularly important. Because, you can move around the band, spot in on local operating portable sets. This of course is caused mainly by the variation in dielectric of said capacitors, and can be avoided by the use of air dielectric. It is also divided by twelve in this rig, and by 18 on two meters. I know! One of my old battery rigs had one such capacitor in it. Every time I got out of the warm car in the fall and spring and started up the mountain to a fire tower, the frequency walked also. Right out of the other fellows *if* pass-band. So if you have only air capacitors you will be better off. This rig does have a mica compression trimmer in it but so far that has not bothered at all. Again, it just doesn't really seem fair to make comparisons between this vfo and others. 4. Heating of oscillator components caused by other tubes in the rig. There are only three of these other tubes, including the modultor tubes. Mixer, final, and modulator. And they are also quick heating filament types. Same 5618 of course, with not much heat in them. If you push the final to its full 7½ watts dc input you will get a little more, but not much. If you use the flat "open" type of construction these last tubes will be a little distance away from the oscillator. That is good for other reasons too. Like rf feedback. 5. "Leaving the oscillator running." Along with all the other evils found in

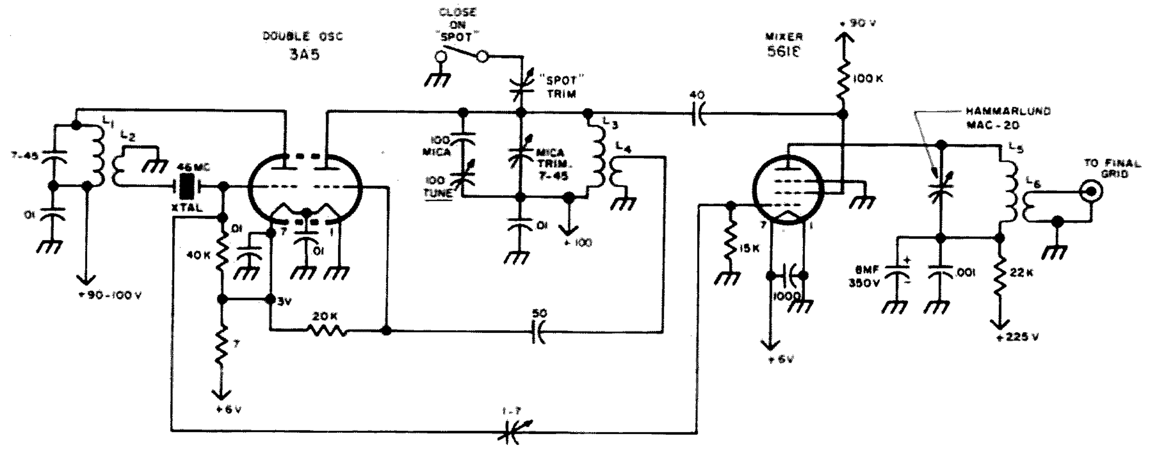


Fig. 2A. Double oscillators and heterodyne mixer.

the "usual" vfo, this is a rather nasty one and has led people to heterodyne mixing of oscillators at low frequencies simply to get the transmitter off your own frequency where you rag chews when mountain-topping or mobile, without the usual work involved in setting up a "stable vfo". Proof? Yours truly had been operating a storage battery walkie-talkie using this arrangement for a long time. See Fig. 1, block diagram.

One half of a 3A5, 55c double triode is used as the high frequency crystal oscillator, the other half as the low frequency variable oscillator. The crystal oscillator 46 megacycle output is fed into the control grid of the 5618 quick heating pentode mixer, and the low frequency variable oscillator, 4 to 5 megacycles, is fed into the screen grid of the same tube.

On the plate of such a mixer can almost always be found *four* frequencies. The fundamentals, 4 and 6 megacycles, and the sum and difference of those two. We will use the sum in this rig.

The reason, for these last two frequencies, is a fascinating subject. Several eminent scientists have written large, good, and costly books about just that one subject. A good number of special tubes have been created just for this service. They are also known as converters in receivers, and as modulators in transmitters. However, we are not going into the theory of mixing here, intriguing though it is. We will have enough to do to make up a good practical rig for battery-portable use, with the main emphasis on why such a design can be made very stable "without hardly trying at all".

The Principle

The principle involved is very simple. Instead of a vfo on low frequency which has to be *multiplied up*, a vfo on low frequency is *added* on. That's all there is to it. A drift, or shift, in the low frequency is *not* multiplied. Example: With an 8 megacycle vfo to take the place of an 8 mc crystal, the 8 mc must be multiplied by 18 to reach 144 mc. Any drift, shift, hum, or what-have-you is also multiplied 18 times. With the heterodyne vfo, no multiplication!

The Circuit

The crystal oscillator circuit I took from the 73 article "Storage-Battery Portable". Just note in passing that these 40 to 60 megacycle crystals work. Look at the thousands of receiving converters using them very successfully, but don't go over 100 volts on the plate. They begin to get fidgety if you do.

The 3A5 triode, each section, does not have much gain so regeneration is used in the crystal feedback circuit. It is not too critical, when used as shown. It just helps to start an otherwise sluggish crystal, keep it going, and provide more output with less critical tuning. Enough reasons?

The low frequency oscillator is also very simple in design. The only thing borrowed from the "conventional" vfo is the use of a fairly high C. A lot of other things often found in vfo's can be thrown away. But, don't forget, there are basic reasons why you can do this here, and *not* do it in the usual vfo. Most of these reasons go back to the main principle of *adding* instead of *multiplying*. 1. Mechanical stability. Not requiring high Q, as the oscillator is a "regulator" type, with plenty of feedback, the inductance LI can be small and light and does not vibrate mechanically, even when you're walking around with it. 2. Heat. The 3A5 is a quick heating filament type tube that does not heat up enough to cause any noticeable drifting, or heat up any of the other components either. In fact, it is turned on and off every time you transmit and receive, as are all the others. 3. Absence of temperature sensitive capacitors. When you use a lot of capacitors across an oscillator coil

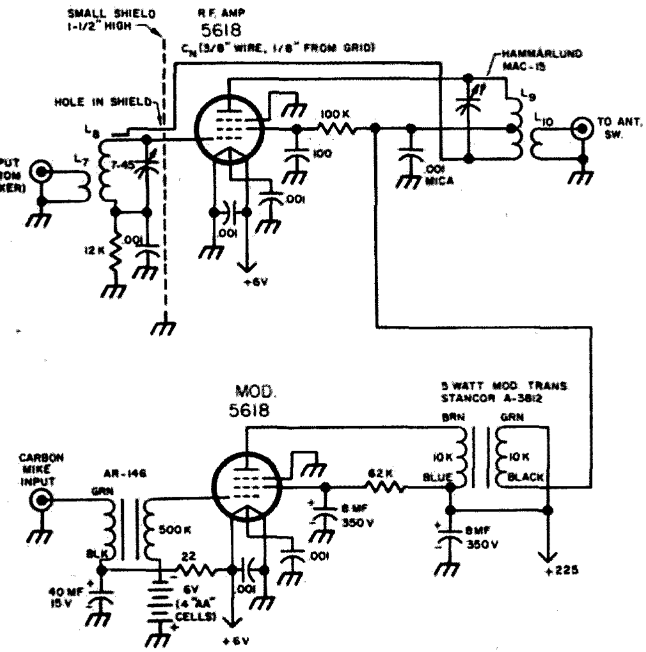


Fig. 2B. RF final and modulator.

you often find yourself with frequency drift, especially when getting in and out of cars and may be listening. And generally are today. The quick heating tubes obviate that one.

So, seems like enough reasons to me. Granted that the remedies for all of these troubles are made easier by the non-multiplication of the variable oscillator frequency. But that's just the point of this entire rig!

The Transmitting Mixer

Now that we have two stable frequencies, one fixed and the other variable, what do we do with them? The crystal oscillator 46 megacycle output goes to the 5618 pentode mixer grid because, being in the VHF region, it does not have much output, for a transmitter, and needs the grid-plate conversion transconductance of the pentode mixer.

The low frequency variable oscillator can have more power (but don't exaggerate on this idea!) and be used to modulate the screen grid. Be sure and keep in mind the meanings of the words mixer, converter, and modulator. The principle and processes are the same but the useage can be different. Note that with the rise of SSB to favor in many quarters we now have people on the air every day talking about converters. They don't mean receiver converters either, they're talking about transmitter converters.

Note the high value of the screen resistor in the mixer, and the dropping resistor in the plate supply. Mixers are particularly fussy about these values, and the bias on the grid or grids. This does *not* mean that they are critical. I do not go for critical circuits, if they can be humanely avoided, but these voltages, that is, control grid bias and screen grid voltage, should be varied under operating conditions for optimum desired results. In this rig it has already been done. The desired results were the maximum output at 50 megacycles from the 5618 mixer with given inputs from the 3A5 and the *least* possible output at 46 megacycles. Also the least at 42 mc, although this latter is no great problem, since it is 8 megacycles away from 50 mc.

Just a word here about the choice of frequencies for the double oscillator. It is obvious that one should not go too near 50 mc, because it would be too difficult to filter out the fundamental crystal frequency (46 mc). Also, the lower you go with the crystal, the higher you must go with the variable low frequency oscillator. It then becomes more and more fussy. In this case, I just happened to have a 46 mc rock, and everything worked out fine. I imagine that you could go a few megacycles lower with the crystal and run the variable oscillator a little higher. But not much! Of course you can get away from this bind by using double conversion, just like in receivers! More on that later, especially on 2 meters and 432.

Tuning the plate circuit of the mixer, which of course should be of the highest possible Q (use airwound coils), you will find both the crystal fundamental at 46 mc and the sum frequency at 50 mc. Be very sure about which is which! I used both a tuned power detector and absorption frequency meters on this job. A grid-dipper in the diode mode is also OK. Use a number of checks on this point! Do not use your high gain sensitive receiver! It helps to have some kind of a marker or small dial on the mixer plate tuning capacitor. Once you get the mixer and the two rf final tuning capcitors on 50 mc you will have no trouble at all from then on.

The RF Final

This operates quite conventionally with the 5618 neutralized. I used a piece of heavy wire, with good flexible tubing over it through the shield wall, brought over near the grid. See Fig. 2b. Works fine. A bakelite screwdriver bending the wire nearer or further away from the grid without rf excitation (watch those plate mils!) shows oscillation or neutralization immediately. Remember, the .24 mmf Cgp isn't much of a capacity but it is enough to make a high-gain unloaded pontode oscillate. You can do an even more precise job using a power diode detector on the rf final output with excitation but no plate or screen voltage. I neutralized this particular rig

about a year ago and it has not budged since.

Again, air-wound coils are used in grid and plate circuits with coax link coupling. Be very sure you are on 50 mc! The rest is straight-forward rf circuitry and works OK. Once all three major tuning capacitors are on 50 mc you will have no trouble.

The Modulator

This is actually the same unit used in the "Storage Battery Portable" rig, described in 73. It is high level modulation and quite uncritical. Be sure to use fixed bias on the grid return and just remember that the 5618 likes class A audio. There is not much current upswing when talking. At the 5 watt level this class A type is still very good. You could make up a class B stage, but why? The storage battery driving the 225 volt hv transistor power supply might hold its charge a few minutes longer, so what? And you would have more and different tubes to buy and use.

Again, for the microphone, don't use anything but a Western Electric F1 button. I worked for the Bell Telephone Laboratories, Member Technical Staff, but that was over 20 years ago. I don't own any ATT stock either. In fact, I don't own. If anyone knows of another carbon mike that fully drives a single tube modulator, sounds like a crystal mike, and can be bought for $1, please let me know.

The Spotting Circuit

Let's face it, the 6 meter band today, especially evenings and weekends resembles the ten meter band in those vintage sunspot years, '39, '48, and so on. This situation settles the rock-bound versus moveable question. That is the main reason for this article. On top of that, the rig is fine in the car, real quick like, with a rain-gutter antenna, UHF connector, cable through the little vent window, and possibly a jumper over to the car battery to keep the portable one charged ready for hiking up on top of the hill away from other mobileers! I have found that the whip up from the rain-gutter at some 45 degrees is very good. Kind of takes care of both beams and other whips. Incidentally, my whip has a stiff gooseneck at the bottom which is very handy for fixing in position and still allow for those low-hanging branches which you will find on those high country roads.

When you arrive at that hill-top and get on the air, you will hear all kinds of local (5, 10, to 15 miles) rag chews going on. If you are rock-bound you might as well have stayed in bed. With the circuit shown you flip the spot switch, zero beat, and you are ready to cut in at the proper moment. No comments, please, on just what moment that is, "Joe, do you know a Mr. Break in this group?" Hah! Spoofing aside, try giving up the spotting gimmick once you've used it!

There is a little deal on the power used for spotting. As shown, the 3A5 alone gives just about the right amount of power for the job. The 3A5 filament should be connected to the spotting switch for this business. I have not shown a complete organization of the switch, because many different possibilities are feasible. I actually use a 45 volt B battery for the receiver section, and add another making 90 volts for the 3A5 supply. You might want to drop down from the hv supply for this. Watch out for modulation on the supply though, if you do.

Notice the "spotting trimmer". This turned out to be quite important and a great help. It is needed to avoid the following trouble. If you want to be able to hear the station that you are zeroing in on, you cannot turn on the full rig. If you do not turn on the full rig you will not be on frequency. So the little trimmer takes care of that real neat like. To adjust it, tune in the transmitter full power on another receiver, shut off the transmitter and turn on the spotter, without touching the receiver. Adjust the trimmer till the spotting frequency is the same as the transmitter. That's all. Just do it once and forget about it.

Send Receive Switch

This also comes out of the Storage Battery Portable rig. Simple deal, using short connections on the transmitter, receiver, and antenna cables. For cables I have used both RG-58/U and the small ⅛ inch miniature 50 ohm cable. Both are ok. See Fig. 3.

For Antennas. Don't forget the gooseneck whip, the telescoping folding dipole, and the 4 element beam that folds up into a golfbag.

. . . K1CLL

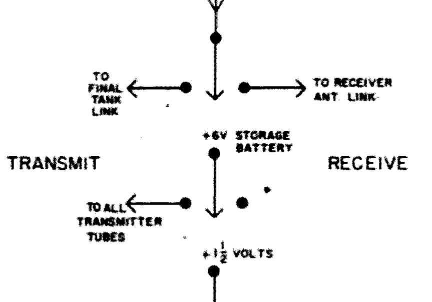


Fig. 3. Switching connections.

Carl Henry
202 Dellwood Pl.
Chattanooga 11, Tenn.

Build Yourself a Light Wattmeter

Every week brings something new in the hectic field (or pasture) of electronics. Attempting to solve old problems with new components is an interesting pastime for electronics enthusiasts, but they must be careful not to put their foot in the wrong thing. One of the new components is the cadmium sulphide/selenide photocell. A semiconductor sensitive to light is not an entirely new concept, since selenium cells have been around for some time, but the degree of sensitivity makes the cadmium cell stand out.

In measurements especially, there are many possible applications for cadmium photocells. One measurement in particular is usually difficult for the amateur, and this is power measurement. There is a way of using cadmium photocells to measure power, and I call this circuit a "light wattmeter". Operation is just as the name implies, that is, the power is used to generate light which is measured by the photocell.

You have probably realized by now that we are going to use a light bulb as a load. Now this is frequently done in amateur circles, but no one will go out on a limb as to its accuracy. Except me. We know that the ordinary lamp filament has a positive temperature coefficient. Fig. 5 illustrates the variation of a typical lamp filament resistance with input power. By keeping this in mind, fairly good accuracy can be had. Of course, if you use a different lamp, the curve will still apply, but the resistance will be different.

You can run your own graph, however, by using the setup shown in Fig. 2. Either dc or ac can be used, and since the lamp has little inductive or capacitive effect, the readings taken will be good to better than 100 mc. After you have a graph on the lamp you are using, you can effect any kind of impedance match you wish.

Using a lamp as a load simplifies the problem of power measurements because loads for this service are hard to come by. Power resistors are too inductive, and when they approach 1000 watts, they become downright expensive. However, even a 1000 watt lamp is not too expensive.

Fig. 1 shows the circuit that I used as the basis of this article. A standard 150 watt lamp was used here as a load. The photocell is mounted about five inches from the bulb. A wooden box houses the wattmeter, completely sealed internally against extraneous light. Figs. 3 and 4 illustrate the variation of resistance of the photocell with variation of power applied to the lamp. Even very small amounts of power are measureable, if the cell

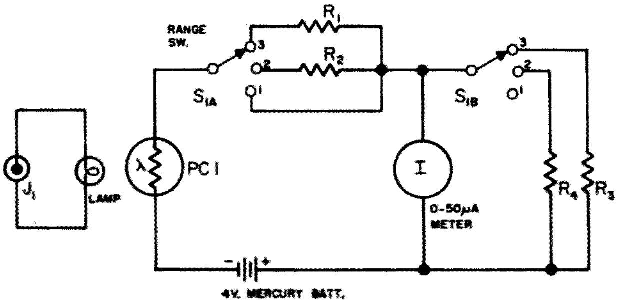


Fig. 1. Circuit of Light Wattmeter.

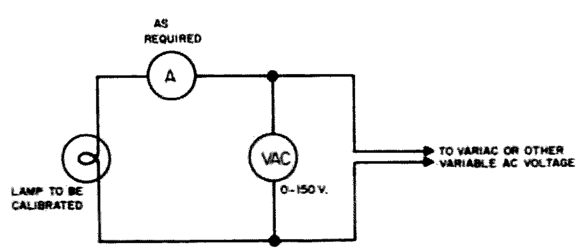


Fig. 2. Method of calibrating lamp and determining resistance.

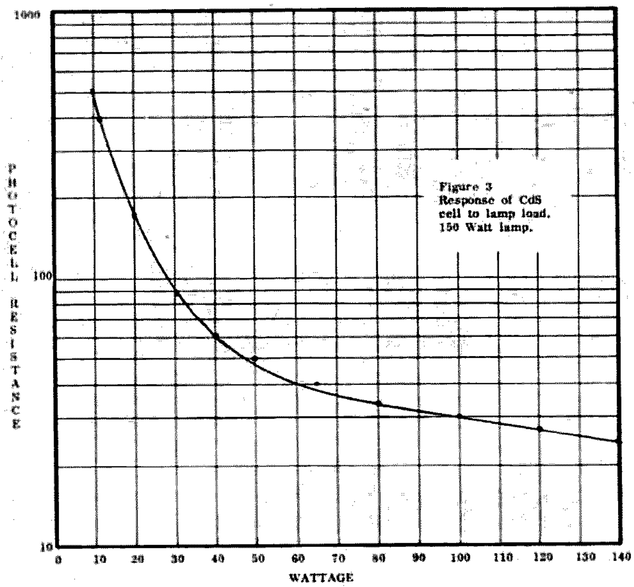


Fig. 3. Response of CdS cell to 150 watt lamp.

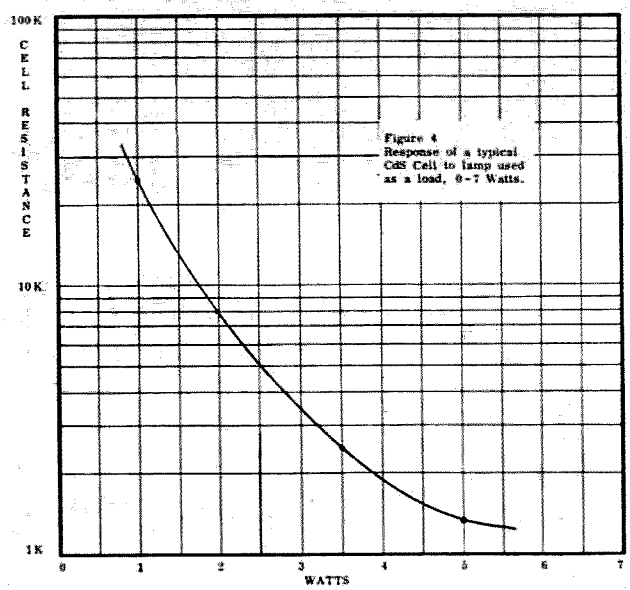


Fig. 4. Response of cell to 7 watt lamp.

is shielded from external light.

The wires from the input connector to the lamp are kept as short as possible by removing the lamp base and soldering the lamp wires directly to the coaxial connector. Switch SI selects three ranges, which can be set by the builder to anything he desires. In my case I used three ranges which cover from 0.5 watt full scale to 250 watts full scale. With some photocells a 1.35 volt mercury battery can be used instead of the 4 volt battery shown. Also, I used a 50 microamp meter, because of convenience (mine), but even a 10 ma meter will work. Don't exceed the rated power dissipation of the photocell, and remember this may derate with increasing ambient temperature. One thousand watts in a box can be a lot of ambient temperature.

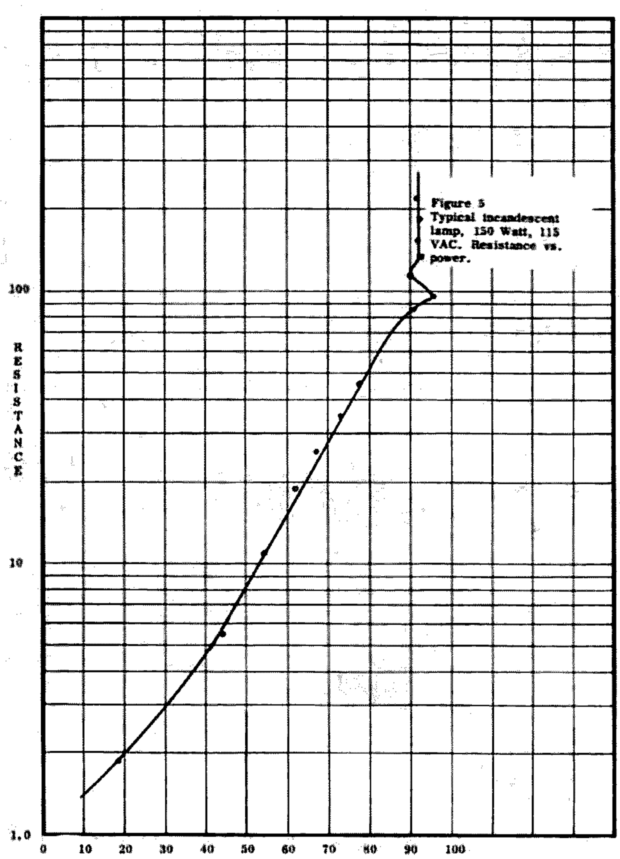


Fig. 5. Resistance versus power input, 150 watt lamp.

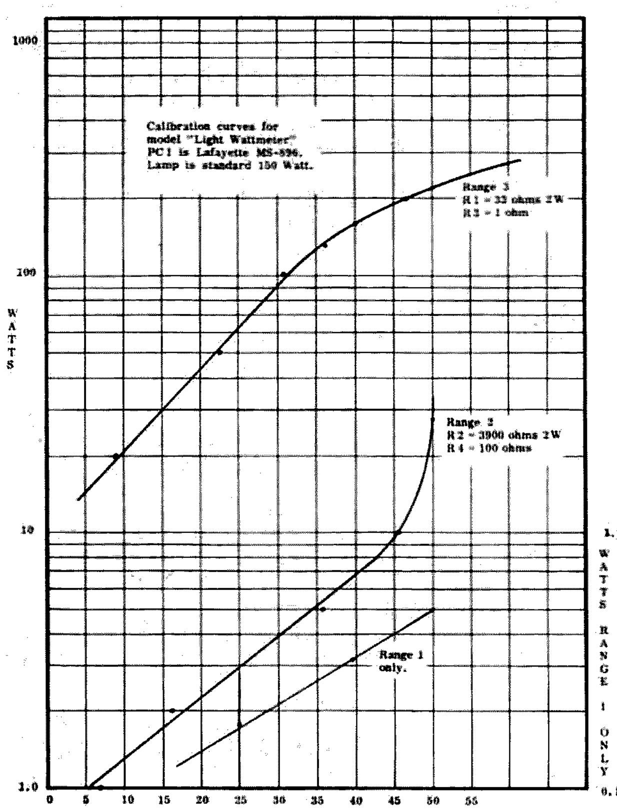


Fig. 6. Calibration curve for Light Wattmeter.

Getting back to the accuracy, if I were to tell you what the meter would read with such and such a lamp, and a given power input, your calibration would be off ten to twenty per cent when the construction was finished. The best way of getting a good calibration is something you've heard before; "if you want a job done right around here you've got to do it yourself".

Now obviously you can't calibrate the wattmeter at 14 mc, because this is what you are trying to measure to start with. Luckily the light from the lamp filament is primarily a power function, and it doesn't matter whether this is dc power, or 100 mc power.

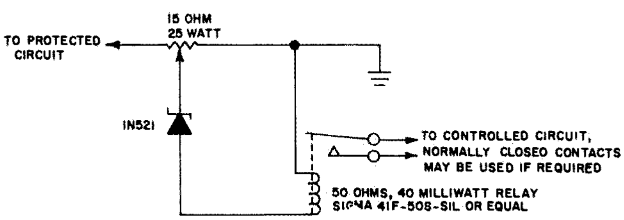
So, to calibrate the wattmeter, apply ac or dc as you wish. Measure the input voltage and current, and read the meter. Make a graph of input power vs. meter reading, and there you have it. Fig. 6 is the graph that I use with the circuit in Fig. 1. Keep the impedance variation in mind, and select a lamp with the power impedance so that standing waves won't eat up lots of your power. As a dummy load and approximate power indictor this is not too critical, of course. But if you wish accurate power measurements, your impedance should be approximately matched.

. . . Henry

Roy Pafenberg W4WKM

Zener Diode Improves Overload Relay

Electronics is a fascinating field. Startling new components are regularly introduced and dramatic applications advanced. Then, as these components become generally available and drop in cost, more and more applications are found. Old reliable circuits are reexamined in the light of the new components and, quite often, great improvements in performance are gained at little increase in cost and complexity. The zener diode is one such component that has updated the performance of many time-proven circuits.



The diagram shows an example of the improvement a zener diode can make in a conventional circuit. The usual transmitter overload relay circuit consists of a relay, shunted by a variable or adjustable resistor, connected either in the cathode circuit of the protected stage or in the high voltage power supply negative return. The resistor serves as an adjustment of the trip point of the relay. The relay contacts are connected in some portion of the control circuit to remove power when the relay is actuated.

While the conventional overload relay circuit is effective, it suffers several disadvantages. Selection of the relay is usually rather critical since the relay coil current, in normal operation, is just short of the trip point. This static current results in relay heating and often causes failure of the relay coil or erratic operation. Also, in 'phone transmitters, the overload relay often "talks back" as a result of the modulating current variations.

The circuit shown eliminates most of the usual problems. A low voltage zener diode is connected in series with the relay coil. The adjustable resistor is set so as to result in a voltage below the conduction point of the diode so that, in normal operation, no current flows through the relay coil. When the drop across the resistor exceeds the zener voltage of the diode, it conducts, and the current trips the relay. Since the current through the relay is momentary, almost any low voltage relay may be used.

In the circuit shown, the 1N1521 is a 1 watt, 6.8 volt zener diode unit. The relay is a low cost, current operated unit. With the constants shown, the relay is adjustable over a range of from a trifle over a quarter of an ampere to almost two amperes. In the circuit shown, the diode is polarized for use in the cathode circuit of the protected tube. For use in the negative return of the high voltage power supply, reverse the diode in the circuit.

. . . W4WKM

Handy Plug and Socket Adapters

Various handy plug and socket adapters may be made from discarded 35mm film cans. These are made of soft aluminum and will readily accommodate many different types and sizes of plug to socket (and vice versa) arrangements to suit your particular needs. Two configurations which I found valuable in my shack are shown in the photo.

As you can also see, I am well stocked with cans! In fact, I have about 75 more than I need, so if any of you don't happen to have photography as a hobby also, send me a stamp and I'll mail a can back to you. The cans will be in perfect shape when they leave here . . . how they arrive at your QTR is up to the Post Office Department.

. . . W3WTO

Joseph Bialon K2GOI

Modifications to the HE-45

I am sure that many HE45 owners would appreciate a higher percentage of modulation. Well, for the cost of about $1.50 this fine transceiver can put out a signal that can be respected.

Modulation

Turn the set upside down so that the modulation transformer is on the left hand underside. Now look to the rear of the chassis and you will note a terminal strip having six terminals. As received, the brown lead will be on terminal. If just the opposite, reverse so that brown will be on pin #1 and white on pin #2. Now proceed as follows: disconnect brown lead from pin #1; tape this lead and leave it disconnected; place a wire from pin #1 of terminal strip to pin 5 of the 6AQ5 (the plate pin). This change alone will increase modulation to approximately 60%. With the addition of a 12AQ5 connected in parallel (all but the filament, which is connected across the filament transformer, the modulation will increase to approximately 90 to 95 per cent. The 12AQ5 is mounted in front of the 6AQ5 (be very careful, there is just enough room for the 12AQ5 socket).

Since I have made these changes in my HE45 I have had no bad modulation reports. A few of the HE45 transceivers have been converted in this area and they sound very good.

Drift

The drift in some receivers can be greatly reduced by changing the 15 mmfd temperature compensated capacitor located at the rear of the receiver tuning capacitor to a 15 mmfd zero coefficient capacitor.

. . . K2GOI

George Oberto K4GRY

Improving the Twin City RTTY Converter

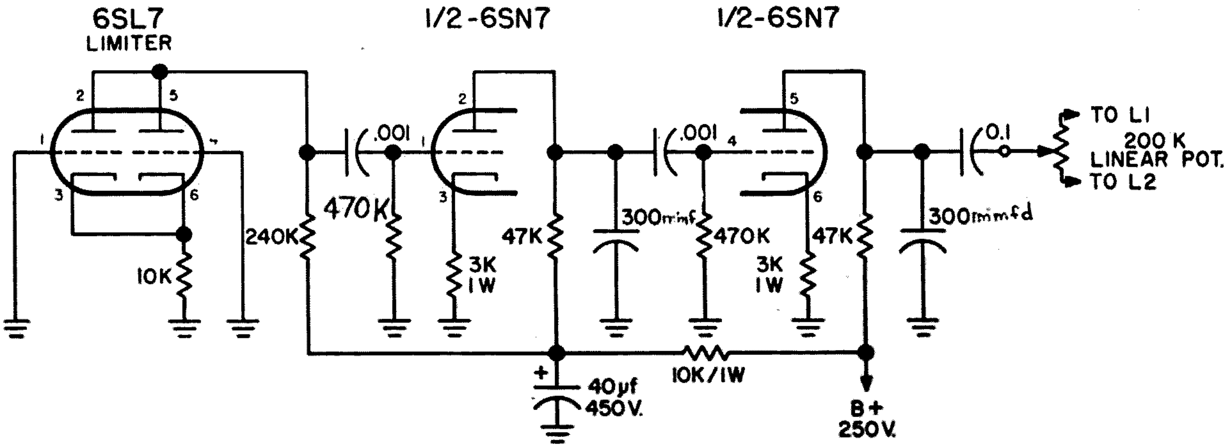
After building the popular Twin City RTTY Converter described in a popular RTTY handbook and magazine the performance of the unit for weak RTTY signals left much to be desired. Finally a 6SN7 was substituted in place of the 6C5 to establish more gain and limiting from the unit. The drawing shows the slight wiring changes including a decoupling network consisting of a 10K 1 watt resistor and a 40 mfd 450 volt electrolytic capacitor.

Surprisingly enough the output voltage of the four 1N64 voltage doubler rectifiers did not increase, but instead the added stage helped by bringing up the weaker signal plus acting as a limiter clipping off unwanted distortion resulting in a worthwhile improvement in the performance of the unit.

The 250 K linear pot shown in the original diagram feeding the discriminator was changed to a 200K linear pot for increase in level to L1 and L2.

Now with a properly adjusted polar relay the simple converter performance is almost as good as a 13 tube TU used for comparison.

. . . K4GRY

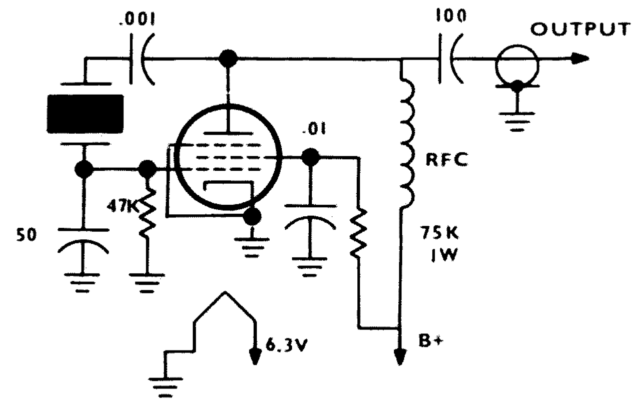


A 12AU7 could be used in place of the 6SN7.

The Novice Note Nullifier

Anyone who has heard DX-35, 40 and 60 series transmitters on the air knows that they sometimes sound a little chirpy when used with crystal control. If you have this problem, the simple gadget described below will solve it. It will give you a good crisp signal with even a sluggish crystal. It is not necessary to modify your rig in any way, so you won't spoil resale value.

As shown by the diagram, the device is a simple Pierce oscillator. A 6AU6 tube was used because we had one and because it will take the voltage available at a DX-40 accessory socket. Another tube type might work better. The oscillator is constructed in a small minibox, which is plugged into the rig's accessory socket. Output is taken via a piece of coax to the vfo input jack. That's all there is



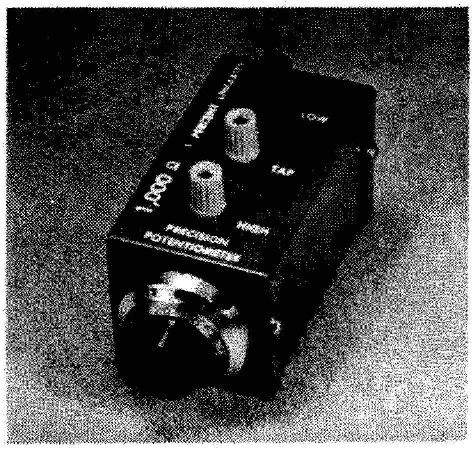
to it. As a bonus, you can plug the unit into your receiver accessory socket and use it as a band-edge marker, with a 3.5 mc crystal.

. . . K6TBW

Surplus Servo Pots for Resistance Standards

Ten turn precision potentiometers have been on the market for several years and are beginning to show up on the surplus market at greatly reduced prices. These rugged units were originally developed for servo and other critical applications and have been widely used in military equipment. To add to the utility of these resistors, turns counting dials have been made available. Most of these dials will count turns and read down to 1/100th of a revolution.

Since most of the available potentiometers have extremely good linearity, it is possible to obtain very accurate resistance settings with turns counting dials. While the linearity of the potentiometers is very good, 0.1% being common, resistance tolerances are not so good. The most common resistors being rated at ±3%. The photographs show an example of available potentiometers and dials.



By selecting a potentiometer with a value of 10, 100, 1,000, 10,000 or 100,000 ohms it is possible to construct a direct reading resistance standard. The photos show such a device. Several potentiometers were available and one was selected which was within 1% of the nominal value. A suitable dial, case and binding posts complete the project. The enclosure is a Bud CU-2103-A Minibox measuring 4″ × 2¼″ × 2¼″. The dial is a Beckman Duodial[R] Model "RB". The binding posts are inexpensive Lafayette Radio MS-566, 5-Way units.

The Borg Model 205 10-turn linear Micropot shown in the photo is typical of available units so a run-down of the specifications is in order. Resistance tolerance is ±3%, linearity tolerance ±0.1%, power dissipation 5 watts at 40° C and rated life is one million revolutions. Mechanical rotation is 3,600° + 15° −0; electrical rotation is 3,600° + 14.4° −0. Physical size is 2⅛″ long and 1¾″ diameter. The shaft is a standard ¼″ and the resistor is fitted with a standard threaded mounting bushing.

These resistance standards are very convenient to have around the shop and you can assemble one in less than an hour. Both the potentiometers and dials have been advertised by surplus dealers in the past. However, your best bet is to visit the surplus dealers and bargain for what you find. Many different types are made and you are almost sure to find something suitable at an attractive price.

. . . W4WKM

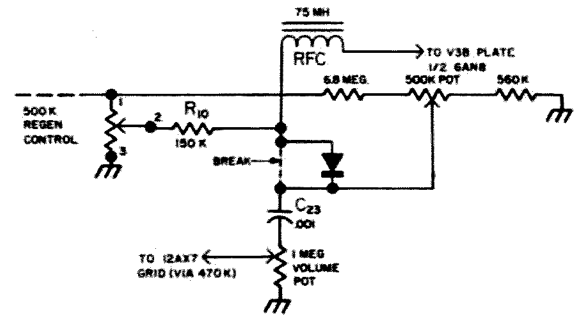
Photography by Morgan S. Gassman, Jr.

Squelch for the Sixer

One of the things missing on the Heath Sixer is a squelch. The Sixer regen really kicks up a fuss when there is no signal on the band. To make contacts in a location where there is little six-meter activity you should monitor the band continuously, but the regen hiss of the Sixer is hard to stand for very long.

Here is a "squelch" for a sixer. It is not a true audio squelch but it is device to kill the regen when there is no signal. This means that strong impulse noises do come through but the regen hiss is not present when there is no signal being received. This device is not as good as a audio squelch but it is a great improvement on the basic Sixer.

The diagram shown is for a HW-29A. The squelch should be adaptable to the older Sixer, but the resistors may have to be changed.



The only new parts needed are a 500K linear pot, a 6.9 meg resistor, a 560K resistor, and a 1N537 or 1N67 diode.

. . . WA9BVS

J. Pflaum K8ERZ

Mobiling in Canada

Scratching his head dubiously as he eyed the Gonset Twins under the dash of my VW, the customs inspector startled me with this query: "Can you seal off that transmitter?"

"Seal it!" I expostulated. "But why? I have a permit to operate in Canada. Look."

I showed him the document, all sealed, signed, and delivered in proper order from the Department of Transport at Ottawa.

Apparently unimpressed, he continued to stroke his cranium.

"Are you going to use this equipment commercially?" he finally asked.

"Commercially?" I countered in amazement. "Of course not. This is for amateur use."

The upshot of the whole business was that he finally let me through, but I am still puzzled. Was he testing me, or are there actually so few U. S. mobiles entering Canada at Windsor from Detroit that my case posed a problem. I can't bring myself to believe the latter, because Detroit is a big city and a big port of entry into Canada.

At any rate, I was soon on my way, calling CQ mobile VE3 (after filling out an inventory of my radio gear, which had to be surrendered when I re-entered the States—the inventory, of course, not the gear.)

Operating in the Canadian phone band had a peculiar effect on me: being so accustomed to the boundaries of the U. S. band, I felt illegal! But after a day or so that passed, and I enjoyed the advantage of being free to use a section of the spectrum that had less QRM, a big advantage to a mobile using only 50 watts AM.

Getting a permit to operate in Canada is easy. Simply write to the Director, Telecommunications and Electronics Branch, Department of Transport, Ottawa, Ontario, Canada. It's best to apply a month ahead of your expected trip, but I received my forms within a week. Don't apply unless you have a General class license or better, as the Novice and Technician class have no counterpart in Canada. You will be expected to indicate in which provinces you will operate and for about how long. They are very generous on the time limit, however. I indicated a stay of only a week but my permit was good for about three months.

At the Canadian exit station at Rousses Point (Quebec, N.Y.) I surrendered my duplicate inventory of radio gear and was passed on to the U. S. immigration officials.

The U. S. man asked me two questions: "Where were you born?" and "Did you have that radio stuff with you when you entered Canada?"

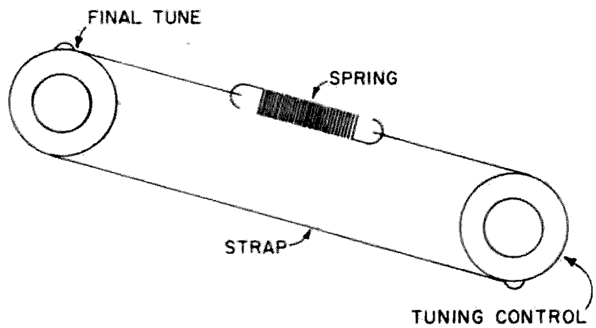
I gave him the answer to the first and said "yes" to the second. With a wave of the hand I was passed on. That was all.

It was great fun mobiling in Canada, and I was successful in making good radio contacts back home to Ohio from Quebec on 20 meters. In fact I talked with my son, via phone patch.

Try it some time. You'll like it, whether you have a son in Ohio or not. . . . K8ERZ

Thomas Rousseau K7PJT

Improve the Tuning on the Heath Apache



The Heath Apache, a very fine rig, has one undesirable feature: backlash in the "Final" tuning control.

I was able to cure this by securing a high tension spring in series with the copper tuning strap. First, a chunk of the strap slightly longer than the spring should be cut about half way between two of the three holes. Next punch a hole about ¼″ from the end of the cut ends. Then reassemble as before. It is very important that the spring have a fair amount of tension, otherwise this change will make tuning worse.

. . . K7PJT

Roy Pafenberg W4WKM

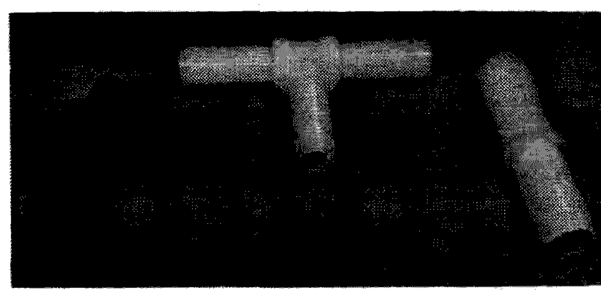
Plastic Pipe Fittings for Antenna Insulators

Flexible plastic tubing is being widely used in certain low cost plumbing applications. To ease the installation task, a line of nylon fittings has been standardized and are now widely available. All of the available shapes, couplings, "T's" and "L's", have potential applications in amateur antenna construction. The excellent insulating, weathering and strength qualities of these solid, thick wall fittings make them ideal for such use.

Although these fittings are in general use, possibly the most dependable source of supply is through the multitude of Sears Roebuck and Company retail and mail-order outlets. The Sears catalog numbers provide a positive identification from local source of supply. In addition, unless you have friends in the plumbing business, prices run a bit lower than in other retail outlets. The following tabulation gives the Sears catalog numbers of the various types, available sizes and prices from their last mail order catalog. Note that the catalog number plus the size makes up the complete ordering description.

Catalog Number	Size and Price ½″	¾″	1″	1¼″	1½″	2″
Coupling						
W42K2308	15c	17c	22c	30c	45c	80c
"T"						
W42K2364	28c	38c	50c	80c	$1.20	$2.00
"L"						
W42K2309	22c	25c	35c	55c	85c	$1.50

As shown in the photograph, the outer surface of the fittings is grooved and these serrations have a slight taper with the outer ridges having a greater diameter than those toward the center of the fitting. In the original application, the plastic pipe is forced over the serrations and secured in place with stainless steel hose clamps.



The smallest diameter of these fittings, at the bottom of the grooves, is approximately the nominal size shown in the chart. The largest diameter varies but is roughly 3/32″ greater than the pipe size shown. For antenna use, the tops of the ridges should be shaved off to make a force or drive fit into the aluminum tubing used in the antenna elements. This can be easily accomplished by sanding, filing or by simply driving the fitting into the tubing. One or two holes drilled through the assembled junction will allow the use of machine screws for greater strength. Of course if you have access to a lathe, you can turn down the available fittings for use with a greater variety of tubing sizes and wall thicknesses.

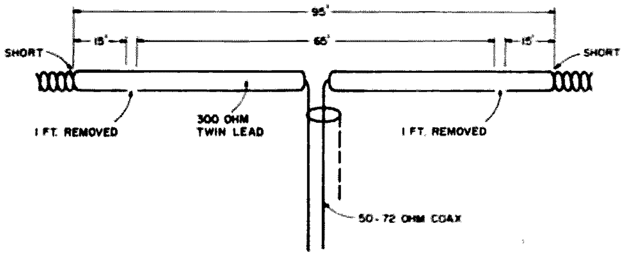
Unfortunately, the number of sizes and wall thicknesses of standard aluminum tubing hhat will give a snug, strong fit with the available plastic fittings is limited. However, here are some examples. The ¾″ fittings, after slight sizing, will make a good drive fit into ⅞″ tubing of the common wall thicknesses. The same is true of the 1¼″ fittings when used with 1⅜″ tubing. It is suggested that you take a look at these fittings and consider how you can adapt them to your next antenna project.

. . . W4WKM

Photo By: Morgan S. Gassman, Jr.

80/40 Antenna on a 100 ft. Lot

Not all amateurs are fortunate enough to live on lots which are at least a half-wavelength on 80 meters long. This is the case of the writer's QTH. There are times when I want to check into the 75 meter state net or keep a sked with a friend across the state, even though the majority of my operation is on higher frequencies. The following is a description of an antenna for 80 and 40 meters that will fit a 100 foot lot.



The antenna is constructed of a 95-foot piece of 300 ohm television twin-lead. The wire is cut into two 47½-foot lengths. An insulator joins the two halves of the antenna and the 50 or 72 ohm coax feed line is connected at this point. A one-foot length of one of the wires of the twin lead is removed fifteen feet from each end of the antenna. This makes one-half of the twin-lead a half wave dipole for 40 meters.

This antenna works surprisingly well on both 80 and 40 meters. The SWR is not as low on 80 meters as found in many full size dipoles, but it does not go over 3:1 at the low end of the band. At 3800 kc, the SWR is about 1.4:1.

This antenna has enabled the writer to have many enjoyable QSO's on 80 and 40 meters on a 100 foot lot.

. . . W8MPD

J. Foy Guin, Jr. W4RLS

Have your 30L1 Cake and Eat It, Too

The 30L1 is an excellent linear amplifier, with many circuit features worth noting (bandswitched pi networks broadly tuning the input on each band, inverse rf feedback, ALC, internal antenna relay, among others). Not the least among its advantages, however, is its light weight (38 pounds) and convenient size (same physical size on KWM-2, including the 30LI's built in ac power supply). This makes it nice for field day, vacation, ham radio demonstration setups at fairs, club meetings, etc.

But it works better on 230 volts! This seems to be the universal experience of those who have tried it both on 115 and 230. I experienced a 12-15% increase in power, while others (W4RHE, for example) have reported as much as 25% improvement. The amount of improvement depends on several local factors, but improvement there will be if the unit is converted to 230 volts. It would be nice to be able easily and quickly to choose either ac supply voltage, since 230 is best for the home station installation, but probably will not be available at remote locations where it is desired to make a temporary station installation.

Collins made provision for operating from either 115 or 230 (covered clearly in the installation manual), but the change is semi-permanent. It means going into the 30LI, removing it from its cabinet, and changing two shorting connections on a five termial strip and changing the power cord. This is a lot of trouble just to have the versatility we are searching for, isn't it? Of course there is a simpler solution.

Find a short length (perhaps one foot) of 5-conductor cable (or homebrew one by passing five pieces of heavy insulated wire into a short plastic sleeve—available from your local electric shop, and similar establishments), and connect one wire to each terminal on the five-terminal strip to which Collins connected the line cord, removing all shorts between terminals. Pass the cable through the hole for the line cord and wire an Amphenol or similar five conductor plug to the other end. Wire a matching five conductor jack to the 115 volt cord and plug, shorting inside the jack cover the same connections which the 30LI diagram shows to be shorted on the five-terminal strip for 115 volt operation. Wire another matching five-conductor jack to a 230 volt cord and plug, shorting this time the same connections inside the jack cover as the 30LI diagram shows to be shorted on the terminal strip for 230 volts operation.

Now, all you have to do to operate from either supply voltage is plug in the proper line cord. You can't mistakenly use the wrong supply voltage, for the cords have dissimilar plugs and cannot be plugged into the wrong ac socket. You have all the advantages of either supply voltage without inconvenience of any kind, and for resale you can easily restore the original wiring.

. . . W4RLS

A. K. McLaren WØCGA
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St. Joseph, Mo.

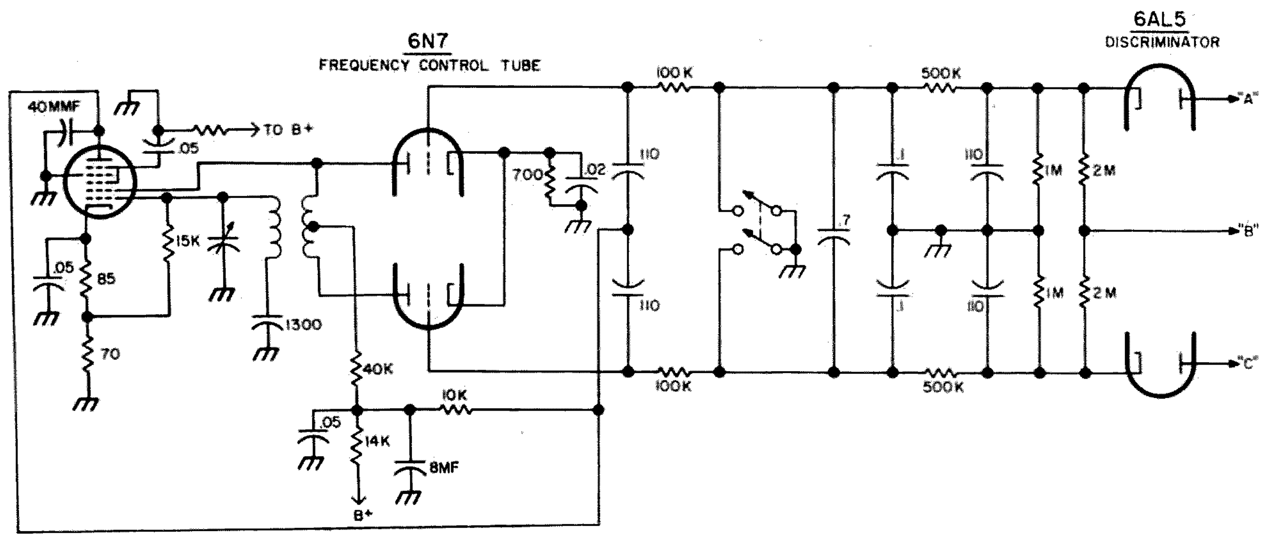
VFO Control of SSB Receivers

Automatic frequency control of SSB receivers is entirely possible and practical. It gives one-hand control of the receiver, and all tuning is done with the vfo. It also solves the problem of zeroing the transmitter, since the same oscillator controls both the transmitter and the receiver.

This system is less tolerant of poorly adjusted transmitters than other systems. Any carrier inserted at the transmitter will cause distortion of the audio signal.

This system can be made to tune the whole seventy five meter band with a fairly strong injected signal. The lock-in range will be less with a weaker injected signal, but the receiver gain will be greater, of course. An adjustable injection signal is advisable.

The receiver can be tuned back and forth within the lock-in range without losing the signal tuned in. Thus any lack of tracking in the rf or mixer stages may be corrected. Only enough front end selectivity to eliminate im-



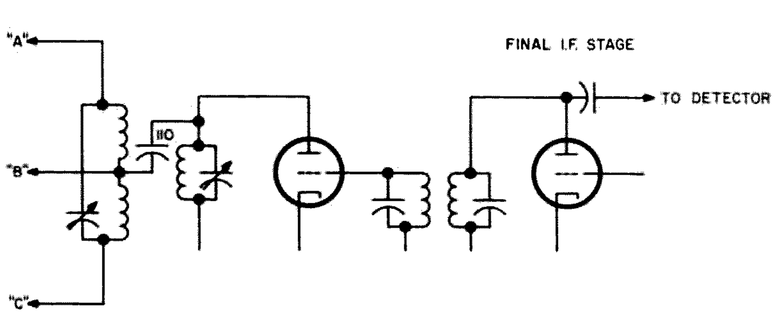


Fig. 1. Schematic of the automatic frequency control, adapter for SSB receivers. There are two errors in the schematic. The resistor going from B+ to ground above the first tube should be connected to the screen grid instead. Also, the center tap of the 6N7 grid coil should be bypassed to ground with a .05 µf capacitor.

ages is necessary; in fact, too much selectivity in the front end will reduce the hold-in range. The selectivity factor must be made up in the *if* amplifier and audio amplifiers. A 3 kc audio filter will eliminate most of the high pitched interference.

Diode detection of the signal is not the best method and synchronous detection or other types may be better. The rectified signal can be taken from the output of the discriminator but here care must be taken not to disturb the discriminator action too much or hold will be lost.

Another drawback to the system is that hold may be lost if operation is too close to a strong local AM station. The continuous carrier takes control away from the vfo.

Automatic frequency control of receivers is not new, of course, but the application to reception of SSB signals is different, to say the least. The system has been used here for many months and has proved to make SSB listening more interesting and pleasant than any method previously utilized.

The avc is left on for best holding action and the receiver can be dropped and knocked about without any effect on the signal. The system should work well in mobile operation, since a good stable vfo will hold the signal regardless of receiver instability.

Fig. 1. shows the circuit used. There are other circuits that can be used, but the circuit shown presents fewer problems, as the only actual connections to the oscillator are the plates of the control tube. The oscillator feed-back coils should be somewhat larger than would ordinarily be used due to the extra load on the circuit.

An adapter unit might be constructed for connection to any receiver by substituting the adapter oscillator for the receiver oscillator and connecting the adapter oscillator to the receiver mixer stage. If the discriminator transformer cannot be obtained, a center tapped output transformer could be used, but a unit built for the purpose will be more stable.

Tuning the system is simple. Tune the receiver to the center of the band, turn on the vfo and adjust until the oscillator locks in. This will be heard as a plopping sound in the speaker. After lock-in has been accomplished, tuning is done by adjusting the vfo. If the circuits are properly adjusted, the vfo will swing the receiver oscillator throughout the ham band. As the vfo is adjusted, an incoming SSB signal will sound high pitched if approached from one side and low pitched if tuned in from the other side of zero beat. At zero beat, the signal should be clear.

The discriminator can be adjusted by using a modulated signal generator. Adjust all *if* transformers to resonance, including the discriminator primary; then adjust the discriminator secondary for minimum sound. The discriminator secondary acts as a trap and a small null should be noted.

The greatest advantage of the system is that the two oscillators are locked together, but on different frequencies.

The injected carrier is at the frequency of the incoming signal and the receiver oscillator is locked an intermediate frequency higher. Thus the receiver oscillator will always be locked in so as to center the signal in the *if* pass band. The pilot carrier will automatically heterodyne the incoming signal for decoding the SSB signal.

The system will not receive AM signals or double sideband signals producing only a steady heterodyne note. However, it operates well for CW reception.

These are fundamentals of the system and many variations are possible, but placing this information in the hands of hams will no doubt result in perfecting the method in a short time. (P.S. The switch shown on the diagram is used to disable the control circuit for normal AM reception.)

. . . WØCGA

Bill Smith KØCER
1301 Churchill Ave.
Sioux Falls, S.D.

VHF

If you have participated in any of the three OSCAR programs you've probably cussed and discussed your antenna system. Signals from these satellites exhibit QSB, apparently caused to some extent by polarization shift from the linear. At a given time, and often within a few seconds, the signal will peak up on a horizontal antenna only to be lost on a vertical antenna, and vice-versa.

What can be done about the polarization shift? Well, circular polarization may be one answer. Very little has been written about the topic although circular polarization has been around for a number of years. It has been used mostly in military and commercial circles, seldom by amateurs.

During OSCAR III, contacts were made by fellows using horizontal, vertical and circular polarizations. It is interesting to note the calls of the successful fellows using circular polarization. It reads like a "Who's Who."

As I said, very little has appeared in print but many of the experienced VHF men interested in space communication agree circular polarization is the answer to dealing with polarization shift. I've tried to find all I could to compare with my own experiences before going out on a limb; I know there is at least one well-known 2 meter man that thinks I'm nuts.

If you have a copy of the January 1962 *VHF Amateur*, look on page 19. Or try Jim Kyle's new *VHF Antenna Handbook* published by 73, pages 28 and 29 or Loren Parks' October 1964 *VHF'er* for an article by W6HPH which closely agrees with what I found to be true. And while you're at it, read the article by W6NLZ in August 1965 *VHF'er* on diversity reception.

Circular polarization can best be visualized in terms of a screw twisting through wood, the screw being a radio wave and the wood representing the atmosphere or space. Screws usually have right-hand threads, circular polarization can have either right or left-hand depending on the feed phase. In some of the readings you'll come across clockwise and counter-clockwise, it is the same as right and left-hand respectively. Incidentally, I'm speaking of standing at the rear and sighting forward down the boom.

Some of you are probably asking yourself if there isn't a loss in signal strength during an earth-bound QSO when one fellow is using circular and the other linear polarization? Some say yes, by 3 db. I do not think so. Here's why. I used a yagi for several months, horizontal to horizontal, over a 30 mile path to KØFKJ; Then I switched to a circularly polarized antenna mounted at the same height, same tower, same feedline. Nothing changed at KØFKJ; I had the same exact signal.

During several months of operation with the circular antenna I became a firm believer that over a given path, beyond where there is definite "groundwave" saturation, the signal is so twisted by the troposphere/ionosphere that there is a good chance that it will not arrive at another antenna in the same sense as it was transmitted. Here is where I believe circular polarization pays off; it is seeing vertical, horizontal and everything in between . . . something like diversity reception. This may be the answer to much of the QSB problem from space or on earth.

If you are going to use circular polarization, be sure and have switching system for selecting right or left-hand because if two stations working each other use the same hand of circular polarization they will experience the same thing as if one was horizontal and the other vertical, something in the neighborhood of a 40 db loss in signal because of cross-polarization. Some of these switching and feed systems first appear confusing and complicated. Next month I will give you some information on how to do it.

In the September issue I offered some charts on coaxial cable characteristics compliments of K2SBV/7. Now I know that there are a lot of you reading this, I got swamped with requests. I'll offer the same deal again. The list is yours for a self-addressed, stamped envelope. And while you're at it, how about some comments and information for the column?

About eight years ago a writer introducing KWM-1 said the SSB transceiver might become a "way of life." Indeed it has on the low bands and is rapidly growing on six. The Galaxy Electronics 6 and 2 meter "Duo-Bander" should be out shortly. I'd guess by next summer's six meter skip season there will be quite a change in six meter operating. The $500 price tag should be attractive in view of some of the gear already available or under development. Write WRL for information.

. . . KØCER

Letter from Gus

Beirut, Lebanon
September 3rd

Hello, readers of 73. Here I am back in Beirut. You know, all that's necessary for an airline to be late is for me to be one of the passengers. We were to have departed from Nicosea, Cyprus (ZC4) at 6:10 PM. Well to make a short story long, it took off late. I mean very late. We arrived here at about 10 PM. But I am getting used to this happening. It always does when I am a passenger. The stewardess said they were never late before. Over in Cyprus customs were good to me. I had all my radio gear, antenna, etc. with me down in my hotel room. I now have it all here in my hotel room in Beirut. I have found what to say when customs asks me that $64,000 question, "Do you have anything to declare?" I always answer them, "I declare I am glad to get to Beirut," and let loose a few "ha, ha, harrs," and usually he will say, "Well, I declare we are glad to have you here." Then he puts his little marks on my luggage and away I go. It's a good thing they have strong armed porters at these airports because if one of these customs officials were to pick up one of those suitcases with the equipment in it some examining would be done pronto! You know, if you go into Israel they won't allow you to enter any of the Arabic countries around here. Well so much for that!

Radio conditions have not been up to par for the past month or two. The W6's and W7's have almost faded out of the picture and all the east coast stations have been weak. But the band has been open for quite a number of hours, even with the weak signal conditions; so this I guess is better than the short openings that I had while in Nepal, Bhutan, Afghanistan, etc. The European QRM is very rough to overcome. But I have found a little trick that helps to partly solve this trouble. I say up 6, up 9, up 12, up 19 and then down so many and tuning exactly to that frequency and tune on away from my frequency. QLM, QHM, etc., don't seem to work as well anymore. I guess there are too many newcomers that don't know what they mean. I use them once in a while just in case someone does know what I mean. I usually have a few QSO's and then my customers run out, and back to the rat race I go. You know I promised the XYL Peggy, I would be home no later than Christmas. Well, I have started counting the days now. Even if I don't get home before the 24th, I've only got 113 days left. The outlook for operation in YK and YI land doesn't look good at the moment. So far JY looks OK and I have a few ideas I want to try when I arrive over in YK and YI. I don't know if they will work but I am going to both Damascus and Baghdad and make a strong effort anyway to see what happens. I am of the opinion it won't do much good though. I will tell you all the story next month. Let's see what happens, eh?

Now about the bands. 15 meters is for the birds. It doesn't even open to Europe, much less the states. I described 20 above. 40 has been pretty doggone good for many Europeans and I have had many QSO's with stations east of the Mississippi. It's still W1EVT for the most consistent signal. W3CRA is just another W3 the past month or so, and I have not heard W5VA at all. The W5's are as scarce as hens' teeth. Parts of South America come through with a bang, especially CP, PY, LU, and CX. Africa is weak, both evenings and mornings. JA comes through in the early evenings and very early mornings with pretty fair signal strength. JA1BRK is always the best. Even the UM8's, UJ8's, UL7's, UA9's UAØ's are weak. BUT those UB5's, UD6's, UA6's, UG6's, and UF6's, boy, they come through like a house afire, practically S9+ all the time. The last W fades out here usually a few minutes before 2 AM local time (2400 GMT). The earliest the W1's come through is about 1430 GMT. But they are weak at that time. They seem to be at their peak about 11, local time (2100 GMT), 4 PM EST. Things are going good with me. My health is at its best and I have not lost one pound since I left home, so I can't complain at all. Boys, that's it until next month.

. . . Gus W4BPD

SEMICONDUCTORS

After a short break, here we are back again. One of the most interesting developments this month is in one of transistors' weak points. Manufacturers have had trouble with cross modulation in transistor receivers, especially low noise ones. The solutions up to now have not been too satisfactory in some respects. A number of hi fi FM sets have used Nuvistors in the rf section to avoid overloading and crossmodulation. Communications receivers have used attenuators in the antenna circuits. Now designers have taken another tack that will probably prove fortunate. It involves the field effect transistor, or FET. This device has been used in low frequency and high cost applications where its tube-like high impedance, resistance to overloading and low noise were important. But FET's have been either expensive or limited in frequency or both until recently. Now FET's have become available that overcome both of these problems (but not at one time.) For instance, the inexpensive (less than a dollar in production quantities) Texas Instruments Silect line 2N3819 and 2N3820 are ideal for AM/FM tuners, mixers, amplifiers, etc. However, they do not offer the ultimate in low noise VHF amplification even though they are perfectly adequate for many applications. Another TI FET, the 2N3823, is used in an experimental H. H. Scott FM tuner and offers exceptional performance. This transistor is capable of a noise figure of less than 3 db up through the 220 mc band, and only 4.5 db at 500 mc with 11 db gain. On top of this, the cross modulation in the Scoot tuner at 100 mc as good as the best tube type tuners, and at least 20 db better than the best "ordinary" transistors. It's not for $19.95 FM sets, though, at over $12 apiece in single lots. The first consumer application I know of for the FET front end is in the Davco receiver. They have modified the front end for FET's to eliminate any cross modulation you're likely to run into. They seem to be determined to beat everybody to all the punches! If you're serious about wanting more information about TI FET's, write TI Technical Literature, P.O. Box 5012, Dallas, Texas.

W6ORG took me to task a bit for overlooking the Sprague 2N2398 as a low noise rf transistor. It costs $3.55 and can give you 17 db gain with a 5 db noise figure. In fact, he's making up a very nice little preamp for 432 using a 2N2398. I received one for trial and it's excellent. At $12.50 complete, or 2 for $23, there's hardly any sense in making your own.

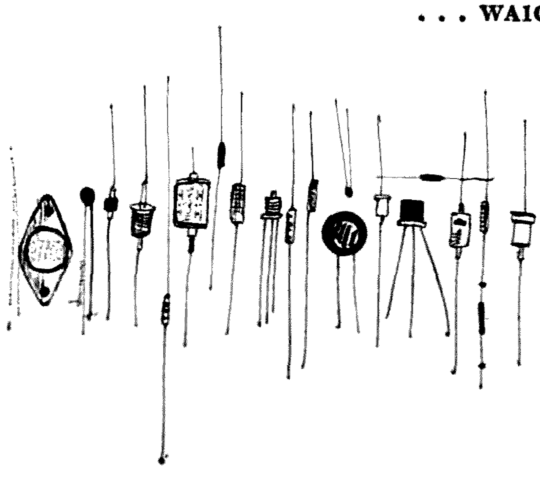
Speaking of low noise rf transistors, K7AAD of Parks Labs and *VHF'er* fame swears by the Amperex 2N3399. There are a number of other new ones that look mighty good. We'd be interested in construction and performance tests on all of these transistors.

New Bendix transistors designed for use in transmitter are the B-3465 and B-3466. The 65 is in a TO-5 case, the 66 in a stud mount package. Price is around $6 and either will put out 4.5 w on 6 meters in class C or 2 w in class A. The high collector-to-base voltage of 100, low output capacitance of 18 pf and other specs make them ideal for this use. More specs? Bendix Semiconductors, c/o Adv Dept 73, Holmdel, N.J.

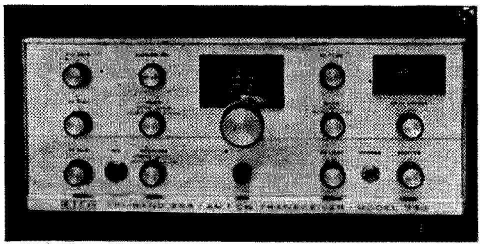
The new ITT 3TE440 can put out 20 watts at 400 mc. It's made for SSB, too. Price? Never mind.

Looks like that's all for this month. Write if you have any pet transistors and circuits.

. . . WA1CCH

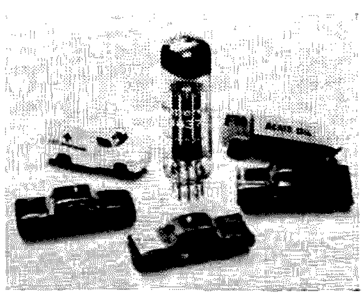


NEW PRODUCTS



Eico Triband SSB Transceiver

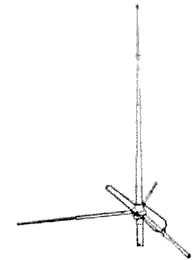
If you've been hemming and hawing about buying an SSB transceiver because the prices on the multiband rigs were a bit too high for you, it's time to act. Eico's new three band (80, 40, 20) gives you 200 watts PEP input for only $179.95 in kit form. It's easy to build with printed circuit boards. Among the features are 1 μv sensitivity, 2.7 kc selectivity, dual speed vernier tuning, receiver offset control, ALC, and many others. You can also get it wired for $299.95. More information is available from Eico, 131-01 39th Avenue, Flushing, N.Y. 11352.



PTTS and the Amperex 8637

Hams have always taken tube ratings with a grain of salt. For instance, it's well known that you can overload most tubes (in terms of CCS and even ICAS ratings) quite badly for short periods and still get very long and excellent service from them. This makes it possible to obtain high power without exorbitant expense. Now Amperex has developed a new rating, Push-to-Talk-Service (PTTS) that takes into account the very short messages normally used in mobile operation. It's figured on a 1 minute on, 4 off basis. The first tube developed for this rating is the 8637. It can deliver 72 watts, yet costs less than half as much as any ICAS of CCS rated tube with similar output. It's a twin beam power tetrode for use up to 200 mc. You can get more information from Amperex Power Tubes, Hicksville, N.Y. 11802.

Mosley Vertical Antennas



Vertically polarized antennas have many advantages for mobile and net operation. Since six and ten are the most popular emergency mobile bands, Mosley has introduced two 5/8 wave antennas for use on these two bands. They are made of high tensile strength aluminum and offer easy mounting, fast adjustment and about 3 db gain over ground planes. The antennas are the Diplomat DI-6 and DI-10. Mosley will be happy to send you a brochure on the antennas: Mosley Electronics, 4610 N. Lindbergh Blvd., Bridgeton, Missouri 63044.

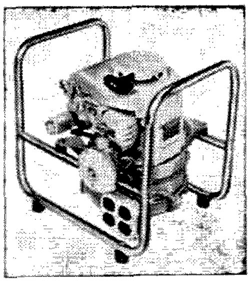
GE Hobby Manual

Most of the projects in the General Electric Electronic Components Division's Hobby Manual are not strictly for hams, but who cares. They are fascinating. All use GE's readily available experimenters' semiconductors and other common components. Theory, construction, specifications and circuits are all included in the 200 page book. Among the projects are light dimmers, musical instruments, automobile accessories, receivers, thermometers, etc. You can buy it for $1.50 from your local distributor or from GE, 3800 North Milwaukee Ave., Chicago, Illinois.

PIC Polyswitch

An attractive new line of coaxial switches is available from PIC. They are compact, handle 2000 watts PEP, take standard UHF connectors and are furnished with attractive indicator plate and knob. Now available are the PS750 SP5T, the PS751 transfer switch and the PS752 SP2T. Want more information? Polyphase Instrument Company, E. 4th St., Bridgeport, Montgomery County, Pa.

Zeus Propane-Fueled Alternators



Zeus has two new propane-fueled alternators available: one of 3000 watts, the other, 1250. Propane offers a number of advantages over gasoline for alternator motors. It is cleaner, easier to store, more stable, causes fewer engine deposits, does not evaporate, and doesn't have gum deposits to settle. In addition, all of the excellent features of Zeus generators are included. Write to Tom Creighton, Zeus Portable Generator Co., 12345 Euclid Avenue, Cleveland, Ohio 44106 for more information.

The Joystick

Quite a lot of discussion has been heard on the bands about the little "Joystick" antenna which is being made in England by Partridge Electronics . . . you may remember this company for their superlative hi-fi transformers.

Well, we've got one of these units right here at the 73 HQ and we've looked it over pretty carefully. I have to hand it to Partridge for the unit is certainly well made. They spared no effort to make it sturdy and permanent. The tubing is heavy guage copper and the center loading coil is well gunked and weather protected. The whole works comes apart for ease of carrying or shipping, the longest single part being about 33".

The Joystick can be used as a portable antenna just by leaning it against the wall or it can be used as a vertical mounted up on a post . . . or even fastened on top of a car for a mobile antenna. The loading coil permits operation on 160M, 80M, 40M, 20M, 15M, and 10M. Versatile.

How does it work? Well, here is what one of our well known 73 writers, W7OE has to say: "I now have my Joystick roof-top mounted, about 22 feet above ground level (base) and have had an opportunity to try it on all bands from 15 meters through 160. I am glad to say that its performance is excellent all the way. It equals half wave dipoles and similar conventional antennas on 160, 80 and 40 and has proven superior to them in the 20 and 15 meter bands. I would most certainly recommend it to anyone looking for an effective 'all band' antenna system and particularly to those who have limited antenna space."

1966 Allied Catalog

Well, here it is catalog time again. If you don't already have Allied's huge 508 page 1966 catalog, send for it today. It's a necessity. You can drool and drool over page after page of new amateur equipment, old ham equipment, industrial and service supplies, hi-fi equipment, Knight kits, books, tools, and everything else a ham needs. Request your copy now from Dept. 7311, Allied Radio Corp., 100 N. Western Avenue, Chicago, Illinois 60680.

1966 Newark Catalog

Newark's 1966 catalog is out too. It's fat and crammed with all sorts of everything electronic. It has all of the ham gear in it, of course, plus a complete listing of all of the industrial components that any ham builder needs. For instance, the catalog contains a listing of over 10,000 semiconductors! Why horse around. You want the catalog. You'll need it a thousand times. Send for it today. Tell them 73 sent you. Dept. 73, Newark Electronics, 223 West Madison Street, Chicago, Illinois 60606.

Lafayette 66 Catalog

I defy any ham to read the new Lafayette Catalog and not get pangs of acquisition. Lafayette has a tremendous amount of ham gear for sale. They also sell boodles of other consumer electronics. Send today to Lafayette Radio, 111 Jericho Turnpike, Syosset, N.Y. Tell them 73 sent you so they'll feel bad about not advertising.

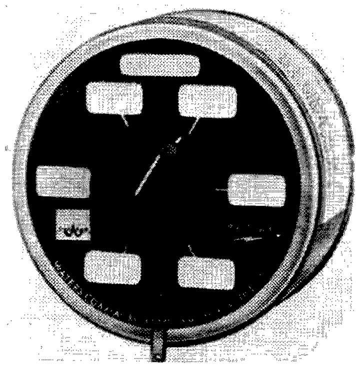
WRL Catalog

The 1966 World Radio Laboratories' catalog just arrived and you'll find plenty of goodies in it. It contains a number of interesting new pieces of gear that we'll be hearing a lot about. Some are from WRL (like a two meter Techceiver), others are from other manufacturers, such as a 80-40 SSB transceiver *wired* for $189 and a 6-2 meter transistorized SSB transceiver from Galaxy, a Hammarlund SSB transceiver that covers 160, the Swan 6 meter SSB transceiver, etc. And the nicest thing is that WRL puts the ham gear right up in front, not hidden behind the CB gear and hi-fi equipment. Just about all the ham gear is listed. Write WRL, 3415 West Broadway, Council Bluffs, Iowa 52504.

Radio Shack Catalog

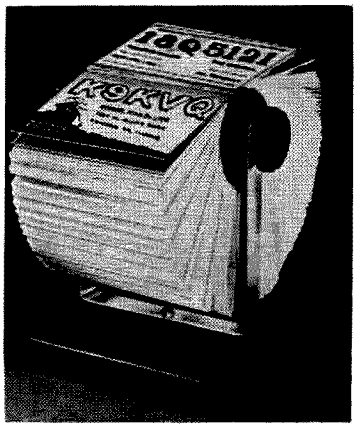
It's a long way from the WRL catalog, since these don't list any ham gear, but the Radio Shack Industrial and #150 catalog list a number of things that would interest most hams. You can get copies from Radio Shack, 730 Commonwealth Avenue, Boston, Mass. 02117.

Waters Protax Coax Switches



Waters has just announced grounding coax switches that help protect your equipment from lightning and voltage surges. Each unused contact is grounded automatically. The switches are provided with a matching escutcheon, knob and all hardware. There are two models, the 375 SP6T axial terminal switch for panel mounting $13.95) and the 376 SP5T radial terminal switch for table or wall mounting ($12.50.) Each is rated at 1000 watts up to 150 mc. Contact Bob Waters at Waters Mfg. Co. in Wayland, Mass. for more information.

Rotary QSL Card Filer



Looking for a nice Christmas present for a ham? The new model S Rotary QSL Card Filer from Nordlund Radio Products may be just the thing. It holds up to 600 QSL's in protective mylar flaps for easy viewing. The unit has an attractive walnut-finished base and comes with holders for 160 QSL's. It costs $10.95. Extra binders provide space for 32 cards for only $1. It's a fine way to protect those valuable QSL's. Nordlung Radio Products, 7635 West Irving Park, Chicago, Illinois 60634.

Letters

advised by my lawyers that
don't you ever proofread y
are a bunch of crooks and
th... for
have no other recourse but
should be tarred and feath

Dear Wayne:

A poll of the Flamigo Net on the ARRL proposal added up to about 90% against and this includes two letter calls, Extras and log time hams. Keep up the great work.

Melvin Page WA4NHT
Miami, Florida

Dear Wayne Green,

Thanks for speaking out for us amateurs. My occupation is being a Roman Catholic priest and I am in no way in the field of electronics. I know enough to understand all of my equipment, but there is no way for me to get any practical knowledge of the other parts of the electronic field. I can improve my code speed to pass a more difficult test, but the theory will probably be beyond me. My $90 a month salary doesn't go very far and it is difficult to eat three times a day, much less buy parts and equipment to get more practical knowledge. I guess I will end up a second class ham if I don't quit entirely. I was proud of my ham license, but I don't feel wanted any more. I am a member of the ARRL because I want to read QST magazine and they count the subscription as a membership. I would rather pay $5 for QST and $10 *not* to be a member of ARRL, if that were possible.

(Rev.) Claude Donndelinger WAØFES
Georgetown, Minnesota

Dear Wayne:

In complete contrast to CQ magazine you paid me $20 for an article back in March '65 and the thing never appeared.

John Schmid WA6PGA

Our prompt and generous payments for articles has resulted in our being almost a year ahead. Now that we've expanded 73 from 96 pages to 128 we will be publishing more articles every month so yours may appear soon.

Dear Wayne:

Referring to your editorial in the August 73 issue, amen! And welcome to the Old-Timer Club.

I see no reason to set anyone on a pedestal—sure, there are glory-grabbers in all walks of life—but in my opinion the system of licensing that has been in use for years gave everyone a chance. There are certainly may other things that the ARRL could have done for Amateur Radio besides instigate this RM-499. I am surprised that Mr. Hoover, who is an older timer than I, should become a party to an act that may do untold damage to our hobby.

I feel that you are sincere in your efforts on behalf of Amateur Radio and wish you continued success with your publication.

Herbert Heath, Sr. DJØKK, ex-W4UE
Pirmasens, Germany

Sir:

A writer of no note, I heartily agree with your needling of CQ. They sat on a story of mine for three years and then waited another full year after publication before payment. Pretty hard to beat that in any publishing house!

Bob Kuehn WØHKF
West St. Paul, Minnesota

Dear Wayne:

I would like to tell you how much K3LNZ and myself enjoyed the hamfest at Peterbourgh on 4 July. It was run as a hamfest should be run. It was refreshing not to have to stand around while one or two in the crowd won a prize or two. Hope to have the opportunity to come up there next summer.

Thom Gooding K4LHB/K3FEP
Chantilly, Virginia

Dear Wayne:

I hope you will print this in your letters column. I would like to vouch for what W8VVD had to say about the two meter band.

From my experience in the past two years on the two meter band I have found it to be a band of many surprises. I use a Heath Two-er transmitter and sometimes I use its receiver. Topside I have a 5 element homebrew beam up 30 feet. Just to give you an idea of where I am located, I am 6 miles southeast of Philadelphia. With the Two-er receiver I have heard from New Hampshire (guess who) to southeast Virginia. I know many more fellows who have heard much further. I have worked with 5 watts in the Two-er transmitter, and 1.0 microvolt sensitivity of the receiver, contacting Virginia, Maryland, Delaward, New Jersey, New York, and Pennsylvania. No station, to the best of my knowledge, ran more than 90 watts in their transmitters. Also, I have worked all these states more than once. This I know is no great feat, because I know of fellows with the same hookup who have worked up into Massachusetts. So I hope you print this for those fellows who are from 40, 80, 20, and 75, who think that two meters are for the birds.

Also, keep up the good work at 73, and don't ever turn into a magazine as full of nothing as QST.

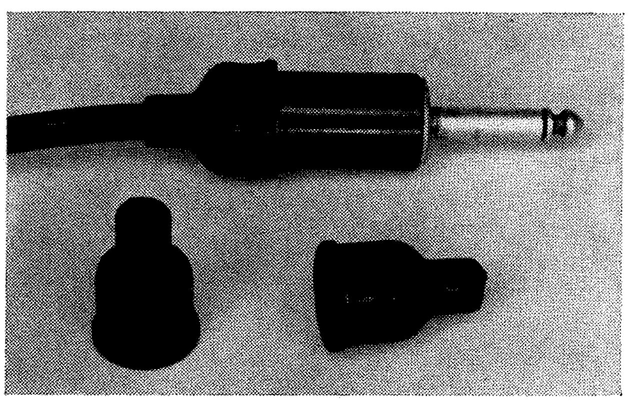
Alan Realey WB2JEP
Audubon, New Jersey

Dear Wayne:

In reading your August editorial of 73 there is one statement you make that I am inclined to disagree with. I think there are two places where you call your self an old timer. I don't feel you can call your self an old timer unless you were licensed and on the air in the twenties. I feel you owe us who can call our selves old timers an apology.

Ted Haas W0BLI
Junction City, Kansas

Alas, apparently I shall never be able to be an old timer. My apology to all old timers whose tender egos have been bruised by my presumption that 30 years hanging around ham radio qualified me as an old timer . . . Wayne.



Auto Insulators

The automotive and hardware counters have always been a prolific source of electronic equipment construction materials. The technique shown in the photograph proves the point.

Rubber spark plug wire insulators are widely available at negligible cost. These insulators are easily applied and perform the dual function of weatherproofing the assembly and providing strain relief for the cable connections. Where outdoor use is anticipated, a small amount of silicone compound will improve the resistance to moisture penetration.

. . . W4WKM

statement shows that QST subscriptions dropped precipitously in 1964 from their poor showing in 1963. Advertising revenues are way down . . . one has to look back about 15 years to find as few pages of ads in QST as today. Sales are down on all QST publications.

With this drop in income we might expect to find some tightening of the QST belt. But no, we find salaries and commissions are up almost $10,000 over 1963 and legal and professional expenses are up from $9,000 to $36,500, an astronomical $27,500 increase over 1963 . . . could this be the cost of the rumored "million dollar" libel suit which we are all waiting to hear about? The employees' pension and insurance expense went from $26,500 up to $42,000, an increase of $15,500 in one year . . . does this tell us how much of a raise Budlong got on his already munificent retirement pay last year? Awfully good raise, if it is. They spent $93.01 for the modernization of W1AW . . . whee!

They lost about $25,000 in 1964 . . . about the same as their increase in legal fees.

False Hope

Apparently several League officials have been telling clubs that we really have nothing to worry about as far as our frequencies are concerned since we have the military behind us 100% and they will make sure that our bands are protected so they will be available to them in case of crisis. Fellows, if anyone tries to snow you with this old chestnut just laugh loudly. Those of you who have been around for a generation or two remember when Colonel Foster became concerned over the possible loss of frequencies at the 1927 Washington Conference. K. B. Warner assured the Colonel that we had nothing to worry about for "the Army would take care of us." This was the conference when we lost 7300-8000 kc and 14,400-15,000 kc, and more, I believe. What would our ham bands be like today if the League had seriously tried to save them for us back in 1927?

I heard the same story about the military protecting our bands for us before the 1959 Geneva ITU conference. While participating as an official representative of amateur radio at that conference I made it my business to seek out and talk candidly with the representatives of our military on the U.S. Delegation. In each case I found that their instructions did not include the protection of our ham bands.

The only alternative that I see to our going

into the next Geneva Conference with the same lack of support is for us to spend the next couple of years getting Congress behind amateur radio so that these delegates will have instructions to preserve our frequencies. The ARRL has flatly refused to lobby for amateur radio in Washington to tell Congress our story. This is why the Institute of Amateur Radio was formed and the job it has to do for us if the ARRL remains adamant in its refusal to try to protect us.

A letter from W6FBW to Huntoon points out the 1927 situation and calls our attention to the feeling of complacency exhibited in the minutes of the Board of Directors as published in the July QST. It is an interesting and distressing parallel.

Author, Author

Now that 73 is 1/3 larger we are publishing more articles than ever. This means that we need more articles. I'd hate to have to go back to a smaller magazine just because I refused to fill in half the magazine with monthly columns of trivia to make the magazine look fat when it actually contained very little. Write up that gadget . . . perhaps we could use a test report on a new piece of gear, or what have you that will be of interest to everyone? See the article on writing for 73 in September for some hints. We can also use some good cartoons and covers.

Mohawk Tip

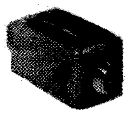
Mohawk owners wishing to calibrate the internal 100 kc oscillator against WWV, will find that they have to unscrew 18 screws—not to mention rear panel connections—in order to get at the adjustment which is *underneath* the chassis.

The following tells how this trimmer can be mounted topside where it can be reached easily. Carefully disconnect and remove the trimmer, and using the same screws, temporarily mount the trimmer topside in the same relative position. With a pencil place a mark directly under the slot in each tab that sticks out from the trimmer. You will find that there is room enough between the shields of the 6BA6 (crystal oscillator tube and 100 kc) to drill a ¼" hole for a rubber grommet. Do the same for the other trimmer tab. After putting in two rubber grommets, the trimmer can be mounted and using number 16 bare wire, to connect each tab to its original connection.

. . . Gino Giannotti

Signal Lack "Punch"?

The model CPR Speech Compressor TRIPLES your average SSB output power; boosts your average AM modulation from 25% to 75%.



- NEW low noise circuits
- Mounts on panel connector
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- For high and low impedance microphones
- Attack time .15 seconds; release time 1 to 3 seconds

only $14.95

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GREAT GIFT IDEA

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for Bendix TV-6/U Tube Testers sent to us by December 30, 1965. We'll pay freight also.

SPACE ELECTRONICS CO.

4178 PARK AVENUE, BRONX, N.Y. 10457

CY 9-0300

Hi-Voltage 400 cps power supplies. Input 400 cps 3 phase 115 v. Output 5300 vdc at 450 ma and 6.3 vac at 2.7 a. Wt. 20 lb. **$39.50**

Spectrum Analyzer. X-Band PRD #854 with PRD #854 unit 8200 to 10 Kmc. **$595.00**

H. P. SHF Swept Frequency Oscillator #670 HM 7 to 10 Kmc. Exc cond. New $850. Our price **$250.**

H. P. 717A Klystron Power Supply. Used with H. P. #670 HM (case slightly damaged.) 800 to 1000 v at 25 ma. New $375. Our price **$95.00**

500 microhenry chokes. Epoxy enclosed. Axial leads. **$1/dozen**

Electrolytics. Dual 35 mfd, 450 v metal can octal plug-in **5/$1, 100/$17.50**

TUBES: RCA 7457 pullouts. Guaranteed good. $65.00 new Our price **$6.50**

4CX300A pullouts. Guar. good. **$11.50**
4CX300Y pullouts. Guar. good. **$13.50**
4X150A pullouts. Guar. good. **$3.50**

All equipment FOB and subject to prior sale.

Government Warehouse, Inc.

264 Shrewsbury Ave., Red Bank, N. J.

Caveat Emptor?

★ **Price—$2 per 25 words for non-commercial ads; $5 per 25 words for business ventures. No display ads or agency discount. Include your check with order.**

★ **Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.**

★ **We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.**

★ **For $1 extra we can maintain a reply box for you.**

★ **We cannot check into each advertiser, so Caveat Emptor . . .**

WANTED TO BUY: a used correspondence course or electronics books in good condition. E. Calvin, 1446 Eighth Avenue, New Brighton, Pa. 15066.

QSL CARDS? Samples 25¢ (refunded.) Sakkers, W8DED, Holland, Michigan.

HT37, P and H LA400C, Telrex TC33B beam. Excellent condition, best offer over $400. Marvin Axt W2ITE, 42 Herrick Ave., Spring Valley, N.Y. 10977.

FROM THE ELI NOTEBOOK: Sine Sweep Generator. A driving circuit for sweep-frequency generators, especially designed for sharp RF and audio filter work. Clear schematic and three pages of notes explain the circuit and how to use it. Complete engineering description. $1 postpaid. Eli Scientific Co., Freeville, N.Y. 13068.

SUPER-TWO'ER. Heath Two'er with factory aligned Lawrence Superhet receiver conversion. $69.00 including mobile rack, Cush Craft halo and Telrex 2M3C beam. All excellent condition. John Ayres K3JZH, 325 Washington, Jermyn, Pa.

COLLINS 51J-3/R388UR. Perfect $400. National NCL-2000 perfect, 5 hours time, $550. Prefer local pick-up. W7WRS, 4200 Lorna Place, Las Vegas, Nevada.

GOING MOBILE—Sell unmarked HQ170C with clock and speaker. $180 or reasonable offer. Also have VF-1 and all band xmtr with 2 6146's, homegrew with 807 modulator. Xmtr needs tuning. No parts needed. Works for $275 or best offer. Art Linehan K1ZCP, 124 A Street, Manchester, N.H.

AERO MOBILE? Benson Gyro Glider. Sell before Winter for $175 or best offer. Art Linehan K1ZCP, 124 A St., Manchester, N.H.

MICROPHONES—While they last EV 664, $44. EV 676, $52. Some used three nights Jazz Festival. Full warranty. Norman Gertz W1KYK, 15 Elmway St., Providence, R.I.

JOIN our Amateur Thrift Club. Pay cash and save. Write for details. Joe Dimare, Box 20672, Dallas, Texas 75220.

HW-22 SSB Transceiver, Hp-23 power supply, GH-12 microphone, xtal calibrator, $125. PE-162-B gas-engine-generator, tool kit, manual, spare parts, $50. K1PSS, 121 Marble St., Athol, Mass.

WANTED: All types Military, Commercial, Airborne, Ground, Electronic items . . . Testsets, GRC, PRC, Collins, Bendix, others. We pay freight . . . RITCO, POB 156, Annandale, Virginia.

WANTED: Motorola HB FM receiver (Sensicon style), Collins adapter 354A-1 (Mechanical filter module for 51J-4, less filters). K8AUH/8, 1208 Richland Ave., Maumee, Ohio 43537.

RTTY CHANNEL FILTERS. Octal mounted, specify frequency, $3 each. Toroids, 88 mh, like new, uncased, 5 for $2.50. WA6JGI, 3232 Selby Avenue, Los Angeles, California.

WANT TO SELL SOMETHING? A want ad in Caveat Emptor costs only $2 for 25 words. 73 Magazine, Peterborough, N.H. 03458.

LR-1 FREQUENCY METER owners: I would like to compare notes on operation and problems. J. S. Hill W6IVW, 26107 Basswood, Palos Verdes Peninsula, California.

RECEIVER R-45/ARR-7. 0.55 to 43 mc. Speaker, power supply. Excellent condition. $150 or trade for ham band receiver WA4DJF, 815 College St., Pulaski, Tenn.

TOO MUCH HAM GEAR, must clean shack. 75A4-$350, NCX-3 with AC supply-$325, SX100 with speaker-$140, Ranger I and 6 and 2 transmitter-$175, Viking 2 with VFo-#90, T-60-$30, Globe Scout-$25, Harvey Wells R9-$50, ART-13 with power supply-$50. K6LVD, 3619 Purdue Drive, Bakersville, Calif.

COLLINS KWM-1, 516F-1 AC power supply, MP-1 12 v DC supply, 351D-1 mobile mount, manuals and cables, $450 cash or consider swap for 75A-4 with vernier dial and filters. Don Droge, 523 Coolidge St., New Cumberland, Pa. 17070.

VANGUARD 6 AND 2 Converters mounted in attractive case with switching, battery holders, batteries. $25. WA1CCH, 20 Pine St., Peterborough, N.H.

TEST EQUIPMENT AND TUBES excess to my needs. BC221AH with book-$75, BC221M with book-$60, TS 175/U-$125, Hickok 288X-$50, RCA Master Voltohmyst-$60, 12-304TL's @ $12.50, 4CX1000 with socket (used) $75, 833A's-$15, many others, write for list. Old tubes, audions, etc., make offer. K6LVD, 3619 Purdue Drive, Bakersville, Calif.

SWAN 350 and 117-C supply. Used very little, in excellent condition $395. Also DX-40 in good condition $29. Jerry Kaczorowski WA8IXN, 3011 U.S. 23 South, Alpena, Mich.

GOING OVERSEAS. Must sell NCX-5 and NCX-A. $515 for both. Also Adcom 250 mobile power supply. Like new $55. WA7BCL, 1757 Gregory Drive, Layton, Utah.

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RECEIVER STRIPS

ARC-21 IF & Audio Strip, 2 MECHANICAL FILTERS, 16 tubes, squelch, ANL, AVC, audio AGC, conversion instructions and ideas to make into AM or SSB receiver .. $12.50

Schematic $1.00

SASE for list:

ROBERT WILSON
6577 S. Newland Circle, Littleton, Colo., 80120

ALL BAND TRAP ANTENNA !

Reduces Interference and Noise on All Makes Short Wave Receivers. Makes World Wide Reception Stronger. Clearer on All Bands!

For ALL Amateur Transmitters. Guaranteed for 600 Watts AM 1200 SSB Pi-Net or Link Direct Feed. Light, Neat, Weatherproof.

Complete as shown total length 102 ft. with 96 ft. of 72 ohm balanced twinline. Hi-impact molded resonant traps. (Wt. 3 oz. 1" x 5" long). You just tune to desired band for beamlike results. Excellent for ALL world-wide short-wave receivers and amateur transmitters. For NOVICE AND ALL CLASS AMATEURS! NO EXTRA TUNERS OR GADGETS NEEDED! Eliminates 5 separate antennas with excellent performance guaranteed. Inconspicuous for Fussy Neighborhoods! NO HAYWIRE HOUSE APPEARANCE! EASY INSTALLATION! Complete Instructions.

75-40-20-15-10 meter bands. Complete $15.95
40-20-15-10 meter. 54-ft. (best for swl's) Complete $14.95

SEND ONLY $3.00 (cash, ck., mo) and pay postman balance COD plus postage on arrival or send full price for postpaid delivery. Complete installation & technical instructions furnished. Free information on many other 160-6 meter antennas.

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777 Vine Street HOLLYWOOD 38, CALIFORNIA

R. F. TOROID KIT. 2 cores, HF and VHF, wire and complete information. Better than coils. Average Q 160. $1.50 plus 10¢ postage. Ami-Tron, 12033 Orsego St., North Hollywood, Cal.

GIANT 20th ANNIVERSARY CATALOG: Increase your product category. TV cameras, electronic equipment, kits, hi-fi, components. FREE copy. Denson Electronics, Rockville, Conn.

SALE TO RAISE TUITION: National NCX-3 ($225). NCXA ($75.) Heath Six'er ($40) and 6/12 vdc ($40.) All excellent. Tony Curtis, P.O. Box 102, Centre Hall, Pennsylvania.

CONVERTERS $10 and up. World's largest selection of frequencies. Ham TV vidicon cameras and parts at low factory-direct prices. See them all now in our full page ad in this issue. Vanguard Labs, 190-48 99th Avenue, Hollis, N.Y. 11423.

DUMMY LOAD. 50 ohm. All bands up to legal limit. Size 3 x 4 x 7. Coax connector. Kit $7.75. Wired $9.95 pp. Ham Kits. Box 175, Cranford, N.J.

ART'S QSLS. Samples 10¢. Art Bliss, 1829 N. Catalina St., Burbank, California 91505.

PRINTED CIRCUIT MATERIALS. Three sample pieces and details. One dollar. Betty Lou Nolin. 35 Arbor Drive, New Hartford, N.Y. 13413

QSL, SWL, WPE CARDS. Sample catalog 10¢. Nicholas and Son Printery, P.O. Box 11184, Phoenix, Arizona 85017. 12 pt. kromkote cards, some originals.

TV CAMERAS. Model 400 complete with good vidicon and lens. Used as demonstrators. Only $200 FOB Vanguard Labs, 190-48 99th Ave., Hollis, N.Y. 11423.

HAM'S DELIGHT! Make strong, lightweight 2 element 15 meter beam for $5.00. New type stands hurricane winds. Locally obtainable materials. Plans for all size beams $1.00. L & M Products, Box 319, Opa Locka, Fla. 33054.

GONSET G 50 Transceiver. 6 meter. Fine condition. $210 or offer. Hawkins WB6CGY, PY 77161, Yucaipa, Calif.

CANADIANS: RME 4300 receiver in good condition. $125. Swap good used 4-1000 for two good used 4-400's. VE6AKU, Innisfail, Alberta.

PICTORIAL STUDY in electrical theory and basic radio communication for the amateur. Understanding through visualization. Free details. Dwight Cross, 1212A Lynch Street, St. Louis, Mo. 63118.

10% DISCOUNT from WRL's Blue Book prices on quality used gear without trade in HT-37-$275; Communicator III (2 or 6)-$169; Communicator IV (2 or 6)-$219; SX101A-$219; SX117-$269; PSA63 250 watt universal PS-$19; Mosely CMI-$95; NC300-$175; NC303-$269; SBE33-$249; Galaxy 300-$219; CE200V-$429; Valiant-$199. Free catalog. We buy for cash. Inquire. Write: Leo WØGFQ, Box 919, Council Bluffs, Iowa.

FAMOUS 572B Hi Power Triodes. Replaces those old worn out 811's $10.95 plus postage. Lorell Distributing Co., 52 Houston St., Newark, N.J. 201-624-5338.

TOROID BALUN KIT. 2" core and #14 Formvar. 4:1 or 1:1. Bandsspreads SWR. 2 KW PEP. $5.00 plus 25¢ postage. Ami-Tron Associates, 12033 Otsego St, North Hollywood, Calif.

NC300 with crystal calibrator, speaker, 6 meter converter. All for just $275. Equipment in excellent condition. Dan VanLoo K8KCX, 5824 Downing, Kalamazoo, Michigan 49001.

WANTED: B & W No. 850A 1 kw Pi-Network assembly, B & W No. 800 RF plate choke, B & W No. FC-30 filament choke. State condition and price. WAØIYR, 1123 W. 35th St. So. Wichita, Kansas.

SRT-14 Synthesizer Modules. Unit 11C now available, also units 6, 8, 9, 10, 11A, 11B. All new, less tubes with schematic $8.00 each or any three $6.50 each. Also schematics any unit, one through twelve, 50¢ or set of fourteen, $3.00. RITCO, POB 156, Annandale, Virginia.

CLEAN EQUIPMENT works better, sells for more. Vacuum Cleaner Hose Nozzles, stem 8" x 3/8", $1.50 postpaid. Spitz, Box 4095, Arlington, Virginia 22204.

IBM EXECUTIVE, 17", bold face #1. Cost new $800 one year ago. IBM maintained, like new $595. 73 Magazine, Peterborough, N.H. 03458.

VHF GEAR. Sell Parks 144-1 (26-30 mc *if*) $42.50 pp; Latest model Parks 432-2 (28-30 mc) $50 pp; perfect 75A-1 with matching speaker $150; Gain, Inc. 432 mc 40 element J- slot array and Hy Gain model 215. 432 gear used only 3 hours for KP4BPZ and then stored. KØCER.

INSTRUCTORGRAPH with 10 reels code tape for learning radiotelegraph code. Like new, $25. Also Eico Grid-Dip meter with coils, like new. $25. Both factory wired. Shipped postpaid in the U.S. Send money order to C R. Carvajal, 600 West End Avenue, New York, N.Y. 10024.

HERE! COMPLETE STATION. 75A-3 0.8 kc filter, speaker, p.d., $305; 20A, Deluxe VFO. Late model, little use, $160. BC-221M, AC supply, $60; new Heath HP-23 AC supply, $36; spare parts, tubes, many new, $35; capacitor checker $4. $575 takes all. Write for details. Ken K8VKC, 790 E. 254, Euclid, Ohio 44132.

TOOBES: 6CW4-$1.40, 6146B-$4.75, 6360-$2.45, 5894-$14.95, 417A-$3.95. New, boxed, guaranteed. No pulls, seconds, or Jan. Free catalog of hundreds more. Vanbar dist. Box 444 x, Stirling, N.J. 07980.

INDEX TO ADVERTISERS

Propagation Chart

November 1965

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	7	7	7	7	7	14	14	14*	14
ARGENTINA	14	7*	7	7	7#	7*	14	21	21	21*	21*	14
AUSTRALIA	14	7#	7#	7#	7	7	7#	14	14	14	14*	21
CANAL ZONE	7	7	7	7	7	7	14	21*	21*	21	21	14
ENGLAND	7	7	7	7	7	7#	14	21	21	14	14	7
HAWAII	14	7#	7	7	7	7	7	7#	14	21	21	21
INDIA	7	7	7#	7#	7#	7#	14	14	14	7#	7#	7
JAPAN	14	7#	7#	7#	7	7	7	7	7#	7#	7#	14
MEXICO	7	7	7	7	7	7	7	14	21	21	21	14
PHILIPPINES	14	7#	7#	7#	7#	7	7	7	7#	7#	7#	7*
PUERTO RICO	7	7	7	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	7#	7	7	7#	7#	14	21	21*	21*	21	14	7#
U. S. S. R.	7	7	3	3	7	7#	14	14	14	7#	7#	7
WEST COAST	14	7	7	7	7	7	7	14	21	21	21	14*

CENTRAL UNITED STATES TO:

ALASKA	14	7	7	7	7	7	7	7	14	14	14*	14*
ARGENTINA	14	7	7	7	7#	7#	14	21	21	21*	21*	21
AUSTRALIA	14	7#	7#	7#	7	7	7#	14	14	14	14*	21
CANAL ZONE	14	7	7	7	7	7	14	21	21*	21	21	21
ENGLAND	7	7	7	7	7	7#	14	14*	21	14	7#	7
HAWAII	14	7#	7	7	7	7	7	7#	14	21	21	21
INDIA	7	7	7#	7#	7#	7#	7#	14	7*	7#	7#	7
JAPAN	14	7#	7#	7#	7	7	7	7	7	7#	7#	14
MEXICO	7*	7	7	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	7#	7#	7#	7#	7	7	7	7	7#	7#	14
PUERTO RICO	7	7	7	7	7	7	14	21	21	21	21	14
SOUTH AFRICA	7#	7	7	7#	7#	7#	14	21	21	21	14	14
U. S. S. R.	7	7	3	3	7	7#	7#	14	14	7#	7#	7

WESTERN UNITED STATES TO:

ALASKA	14	14	7	7	7	7	7	7	14	14	14*	14*
ARGENTINA	14	7*	7	7	7	7#	7#	14	21	21*	2#	21*
AUSTRALIA	2#	21	14	7#	7	7	7	7*	14	14	21	21
CANAL ZONE	14	7	7	7	7	7	7	14	21	21*	21*	21
ENGLAND	7#	7	7	7	7	7#	7#	14	14	14	7#	7#
HAWAII	21	14	7	7	7	7	7	7	14	21	21	21*
INDIA	7*	14	7*	7#	7#	7#	7	7	7	7#	7#	7#
JAPAN	21	14	7#	7	7	7	7	7	7	7#	14	21
MEXICO	14	7	7	7	7	7	7	14	14	14	14	14
PHILIPPINES	21	14	14	7#	7#	7	7	7	7	7#	7#	14
PUERTO RICO	14	7	7	7	7	7	7	14	21	21	21	21
SOUTH AFRICA	14	7#	7	7#	7#	7#	7#	14	21	21	21	14
U. S. S. R.	7#	7	3	7	7	7	7	7*	7#	7#	7#	7#
EAST COAST	14	7	7	7	7	7	7	14	21	21	21	14

Very difficult circuit this hour.
* Next higher frequency may be useful this hour.

Good: 1-9, 13-15, 20, 21, 26-28
Fair: 10, 12, 16, 18, 22, 24, 25, 29, 30
Poor: 11, 17, 19, 23
VHF DX: 2, 8, 18, 24, 29

73

DECEMBER 1965
A Merry 50¢

Amateur Radio

73 Magazine

Wayne Green W2NSD/1
Editor & Publisher

Paul Franson WA1CCH
Assistant Editor

December, 1965

Vol. XXXVIII, No. 1

Cover by Wayne Pierce K3SUK
Cover II by Ray Sox WA2TKY

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Postmasters, please send form 3579 to Good Old 73 Magazine, Peterborough, New Hampshire. Use your Zip Zone and save our shirt.

de W2NSD/1

never say die

As an inveterate rag chewer I take great umbrage at the stupid contests that louse up my rag chewing bands with QRM and with those damned DXpeditions that fill up big parts of the bands with fellows calling hours on end. On the other hand, as a DX enthusiast, I don't see what everyone is complaining about when I take an hour or two to get a contact with Gus. Contests, too, are a ball and I love them.

One of my fondest dreams in the past was to do well enough so I could go out on DXpeditions to rare spots and operate for a few days. This dream was enhanced by my taste of the sweets at Navassa (KC4AF) in 1958. Now, with 73 prospering and with fortune in the offing, the time is nearing when I could consider working out some of my DXpedition dreams.

So what has happened? Between the ubiquitous Gus Browning, Don Miller and Chuck, Lloyd Colvin and the Hammerlund DXpedition of the Month, there just isn't any place left for me to go. Rats. Well, next spring I'm going to see if it is possible to break the Coast Guard's iron will opposing my return to Navassa.

Speaking of Don Miller, I managed to work him at the last couple stops of his . . . HS . . . 1S9, but it was pretty hard work. The bands were really buzzing after Don finally pulled the plug for apparently he had made it a practice of not hearing the top men on the DX lists and many of them found themselves calling him 16 hours a day for almost three days . . . then, just before he went QRT, Don worked them all. I don't know if he was trying to convince them that it would be prudent for them to send some money to support his effort or whether he was just trying to do them one of the best favors he could do them and get them to break the DX habit. This worship of a top listing in QST is a terrible thing. A few hundred fellows take this stuff incredibly seriously. I heard some complaining that Don made them stay away from work for a day so they could work him. Never once did they even consider of what possible importance this contact was to anyone. If Don can bring a dozen or two of the top DXers to their senses he will have helped ham radio more than all of his travels.

On the money end . . . there really is no reason to pay anyone to put a country on the air. There are fellows who have the money to do this and would be happy to do it. When we went to Navassa we accepted donations, but we lidn't really need them. The fellows who go on DXpeditions are more than paid for their effort by the fun they've had.

The basic problem behind all this DX nonsense is, of course, the ARRL DXCC award and the infamous listing in QST of the dis-Honor Roll. I don't think the prefix award of CQ's is any better . . . and I'm the one that brought that darb out. I consider the county award a new height in futility and an incredible time waster. I note with satisfaction that Clif Evans has a county award now so those with soft brains for this trivia can get their certificates from him instead of the now discredited one from Brand Y.

Why do I complain? Well, I like to talk on the air and I get pestered by kids of all ages calling me to get New Hampshire for their WAS . . . they don't want to talk with me at

all, but as long as I'm in New Hampshire they climb all over the stations I'm trying to work so they can get my card. County hunters beware . . . I am the only active station in Greene County . . . because I made the county up.

The other day someone called me and suggested that 73 put out some DX certificates or run a contest. Man, we already have a DX certificate. You'll find a listing of our available certificates toward the back of this issue. I'd like to run a contest, but I really haven't the slightest idea what it should be like. If there are any DX clubs out there that would like to run a DX contest I'd like to hear from you. You'll have to work out the rules . . . I'll print them and get them circulated to the DX countries . . . you'll have to tabulate the logs and let me know who the winners are. I'm willing to make it worth while for the winners to submit a picture of their station by paying, say $100 for the picture of the winning station, $50 for the runner up, and $25 for the next two. I'll also provide certificates for all of the country winners and state, etc., winners. So, any suggestions . . . any offers? Now that 73 has one of the largest DX circulations of any ham magazine in the world I suppose we might as well start a contest of some sort going.

73 Cover Contest

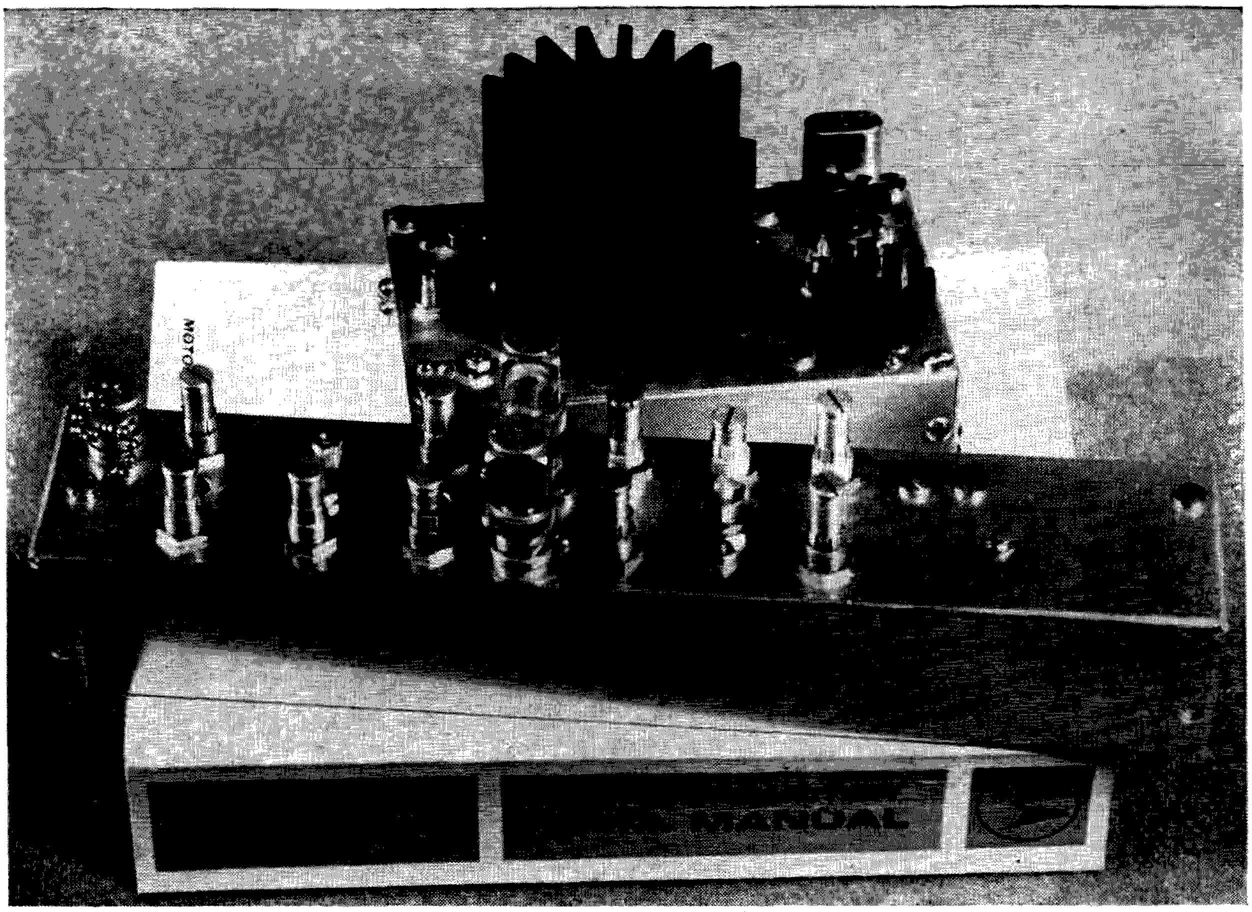
We'd like to have more interesting covers for you, but are held back by the weakness of our imaginations. If you have an idea for a cover you might clean up. The contest will end Feb. 15th. We will pay $100 for the best cover received by that date, $50 for the second best, and $25 for any others that we can use. Covers should be complete and ready for engraving, using a two color overlay. They should be prepared about twice finished size. We're open for any ideas . . . pen and ink . . . charcoal . . . scratch board . . . oil . . . water colors . . . tile . . . linoleum block . . . or whatever you can imagine.

The covers should have something to do with amateur radio . . . please.

April Issue

If you have any interesting ideas for April type articles you should start working on them for we are planning one of the most unusual April issues ever published. We expect this to be the straw that will finally drive both QST and CQ, if they are both still in business, out of what is left of their minds. Articles should be submitted before February first.

(Continued on page 114)



Ronald Vaceluke W9SEK
17 W 540 Hillcrest
Wooddale, Illinois

Solid State 432 mc Exciter

When I was first contemplating the construction of an exciter for my ATV station, I had hoped to have the entire unit solid state.

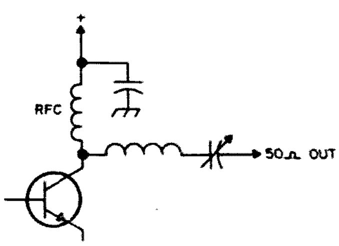


Fig. 1. Alternate output circuit to provide 50 ohm output for the 2N2950.

However, at that time, the prices of the transistors were quite high. I then settled for two tubes and a varactor.[1] Since then prices have come down, as much as 50% on one transistor in particular. It was decided that the plunge had to be made even if for no better reason than my own personal satisfaction.

Although the ultimate goal of the circuits shown is 432 mc energy, these can be broken down to give output power at the following frequencies:

48-50 mc——— 3 watts
48-50 mc———20 watts
144 mc———13 watts
432 mc——— 8 watts

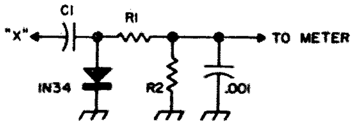


Fig. 2. Typical metering circuit. One needed for each stage.

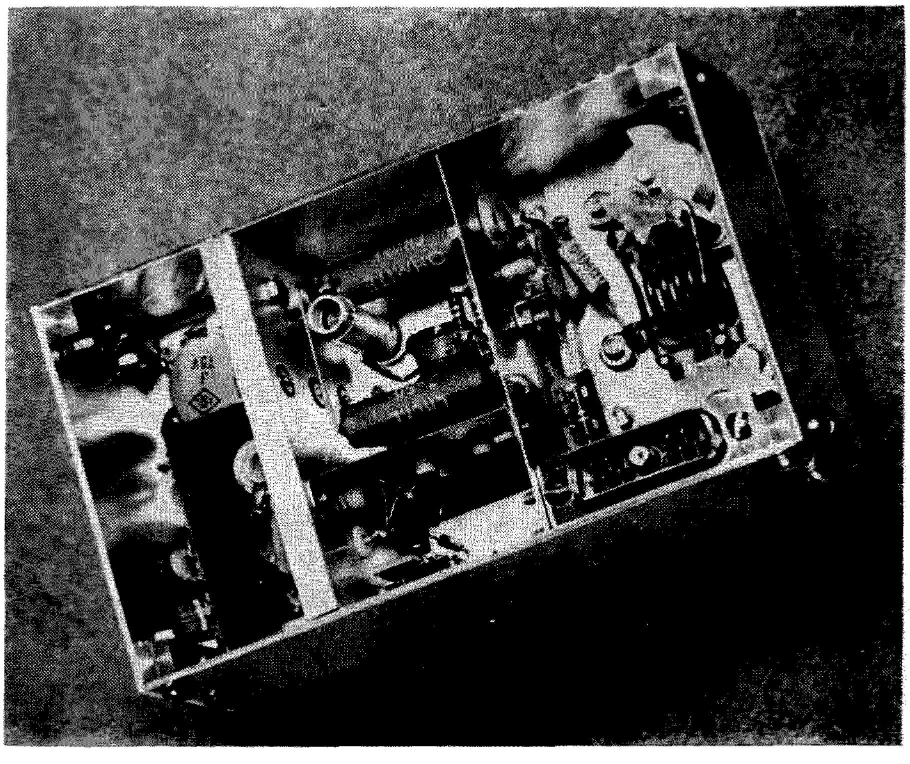
From the above it can be seen that by using the transistorized exciter alone, up to 20 watts can be obtained on six meters. By following this with the first varactor tripler, we then have a 2 meter exciter and of course the second varacter stage gives us the 432 exciter. If only 3 watts is desired on six, then the first three transistors are used. Refer to *Fig. 1* for an alternate output circuit using Q3 to drive a 50 ohm load. With this arrangement I have obtained up to 4.5 watts output with the 2N2950 but this is driving it rather hard. The 3 watt figure given is a safer and more conservative amount.

One thing I wish to bring up at this point is that all of the above figures are under CW conditions and at 24 volts. If amplitude modulation of the transistorized stages is desired, then the collector voltage must be kept down to around 12 volts (on the modulated transistors) with a resultant decrease in output.

It may seem strange to some but my first thoughts on construction was of heat sinks. Since compact construction was in order, a large dissipator was out of the question, yet a big dissipating area was needed for Q4. This paradox was solved with an IERC TO3-250-200. This sink provides ample dissipati n while presenting a small area on the chassis base. This is necessary in order to maintain short lead construction under the chassis. Transistor Q3 is mounted on a piece of 1½" x 2¾" x ¼" aluminum which doubles in duty as an interstage shield. Transistors Q2 and Q1 use smaller IERC dissipators in order to keep them down to proper temperature limits.

One of the most difficult things to get used to when using transistors is the low impedances. Once this fact is accepted, no trouble should be encountered. All circuitry is straight-forward without any fancy frills. In fact most of the basic circuitry was obtained from the data sheets on the Motorola transistors and varactors I used. The inputs of Q2, Q3, and Q4, as well as the output of Q4, are metered by the rectified RF method (see ***Fig. 2***). A diode fed by a small capacitor samples the RF and feeds a voltage divider to provide sufficient DC to give an indication on a micro-ameter. No values are given for these sampling circuits because these will change, depending upon what collector voltages are used, etc. Some may prefer to measure the collector currents but this is up to the builder.

The transistor exciter (**Fig. 3**) is built on a piece of 4¾" x 2¾" 16 gauge aluminum. The corner posts are made of drilled and tapped



Bottom view of the 48 mc driver. Note Q3 mounted on ¼ inch heat sink/shield with a shield between the base and collector.

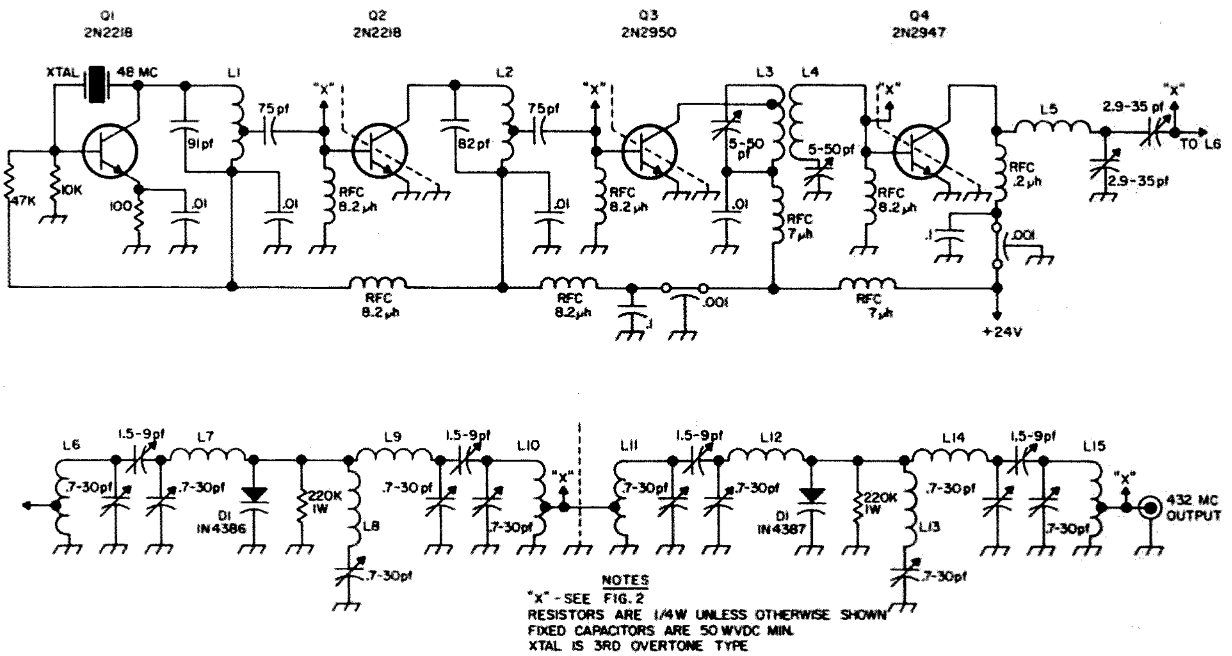
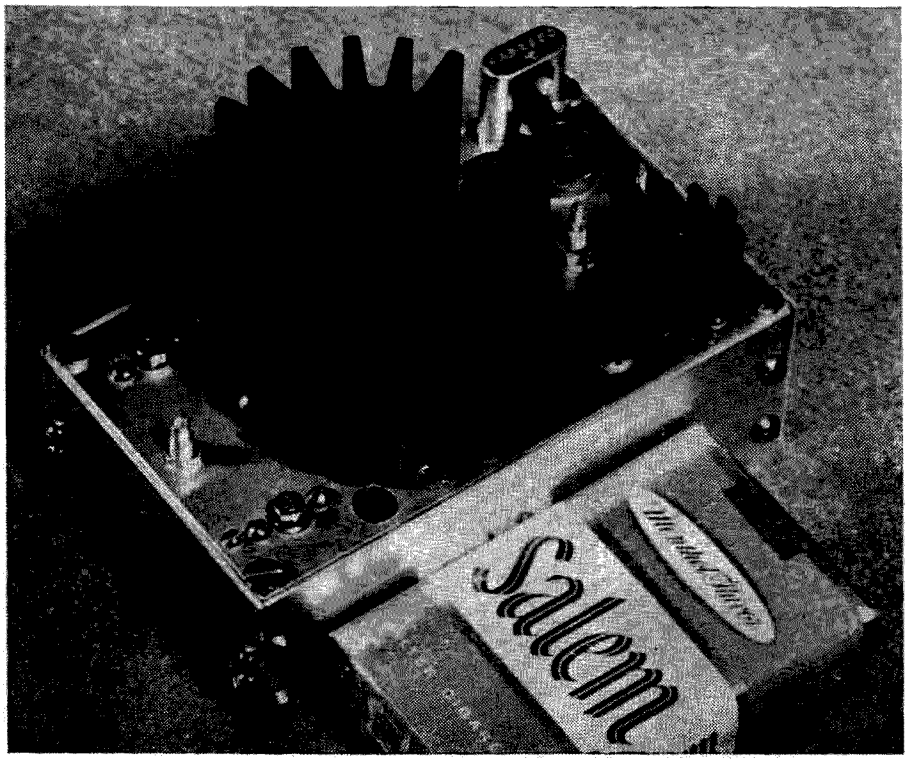


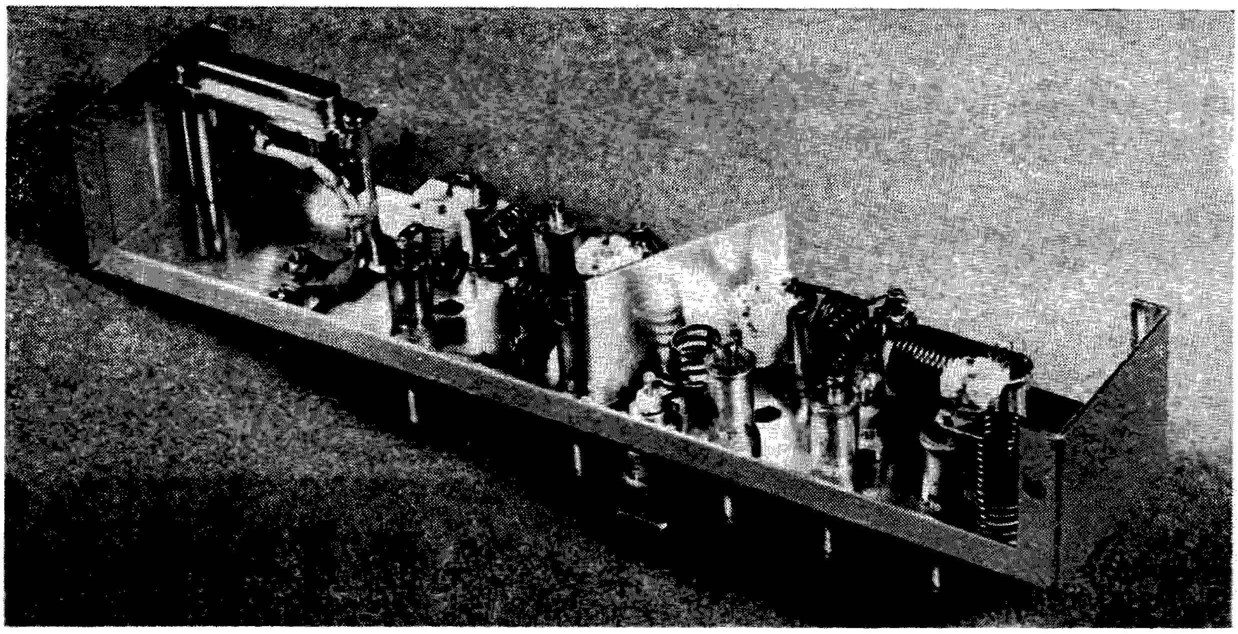
Fig. 3. Solid-state 432 mc exciter. The top section is the 6 meter driver good for 20 watts output. The bottom is the dual tripler using two varactors to get to 432 mc. Heat sinks are: Q1, IERC TXBF-032-025B; Q2, IERC LP5A1B; Q3, see text; Q4, IERC, TO 3-250-200.

¼" square brass rods. Four pieces of aluminum fasten to these rods to form a complete chassis. The two varactor tripler stages are built in a 1⅝" x 2" x 10" minibox; however, the entire circuitry can be built on a single larger chassis. The two chassis construction I used was to suit my particular requirements in my ATV project. The only things to be sure of in construction is to have short leads and proper shielding between stages. Power and RF connections on both chassis are brought out on miniature connectors which have their mates on a master chassis in my project. The coax connectors on top of the units shown here are just for testing. However, the builder can choose whatever method serves him best.

When tuning up for the first time, it is recommended this be done stage by stage and



Top view of the 48 mc driver. This unit will produce 16-20 watts depending on the individual transistors used.



Bottom view of the varactor multiplier stages of the solid state 432 mc transmitter. On the right is the multiplier from 48 mc to 144 mc. Left of the shield is the multiplier from 144 mc to 432 mc.

disconnecting power to the preceding stages. All three amplifier stages are run Class C so when drive is removed there is no current flow; however, a stage that has drive but has its output out of resonance can be damaged. Tune up can be done much more safely with a lower voltage and a regulated supply with high and low voltage output is recommended.[2] If the exciter is tuned up at low voltage it will have to be re-peaked when full voltage is applied. This is because the junction capacity varies with voltage but all tuning will be quite close because of the high C circuits used in the outputs.

The two varactor triplers are of straightforward design which have been described many times before and we need not go into it again. The same applies to tune up but it is recommended that the first stage be tuned by itself before the second stage is connected. I have a jumper made of two right angle BNC connectors for tune up purposes. This is normally left connected but can be removed and a directional wattmeter inserted in the line for checking efficiency, etc.

Of course 432 mc is not the high frequency limit to the use of varactors. Quite the reverse is true in that varactors perform well and are most practical as the frequency goes up. The exciter described here could be followed by another varactor tripler (such as the Motorola MV-1808 as an example) and give about 4.5 watts output at 1296. Although I haven't tried this scheme yet, I would like to and describe it to the readers of 73.

This manuscript is not submitted primarily as a construction article but to show mainly what can be done today with available semiconductors. By available I mean that they can be purchased from large industrial parts houses (such as Newark Electronics) and are not merely laboratory curiosities. The devices shown here are not cheap and yet they are not unreasonable when thinking of long term usability. As time goes on this type of semiconductor circuitry will become more and more common. When this happens you can look back and say, "Shucks, *73 Magazine* had that a long time ago—so what else is new?"

. . . W9SEK

1. "A Hybrid 432 mc Exciter," *73* March, 1965, Pg. 38.
2. "A Regulated Solid—State Supply," *73*, December, 1965.

Coil Table

L1 and L2	4 T #18¼" dia. Tap at 1¼ T from cold end. ¼" long, slug, tuned. X
L3	4½ T #18 7/16" dia. Tap at ¾ T from collector end. ¼" long.
L4	4½ T #18 7/16" dia. ¼" long.
L5	4½ T #14 9/16" dia. ½" long.
L6	12 T #16 ⅜" dia. Tap at 3 T from cold end. 1" long.
L7	13 T #16 ½" dia. 13/16" long.
L8	4 T #16 5/16" dia. 7/16" long.
L9	4 T #16 ⅜" dia. ½" long.
L10	4 T #16 ⅜" dia. Tap at 1 T from cold end. ½" long.
L11	4 T #16 ⅜" dia. Tap at 1 T from cold end. ½" long.
L12	4 T #16 ⅜" dia. ½" long.
L13	3½ T #16 3/16" dia. ⅝" long.
L14	2 T #16 ¼" dia. ⅜" long.
L15	3 T #16 3/16" dia. Tap at 1 T from cold end. 13/16" long.

Augusto Lovisolo I1LOV
Malnate, Varese, Italy

8058 Nuvistor Preamplifier for 432 mc

This preamplifier is built around the 8058 Nuvistor triode which is especially designed for grounded grid rf amplification up to 1200 mc. In practical tests, it outperformed the 6AM4, the EC88 and even the WE 417A, which never seemed to work too well at these frequencies anyway. Two of these amplifiers could make a good front end for a crystal mixer converter. They would easily cover the 4 mc bandwidth usually required for such converters (430 to 434 mc). At I1LOV, we use one ahead of a modified Centimeg converter with two stages of rf amplification to get up over the noise for the weak signals. Since the plate circuit tunes continuously from 410 to 440 mc, it can also be used to tune in some commercial radio links from 418 to 425 mc.

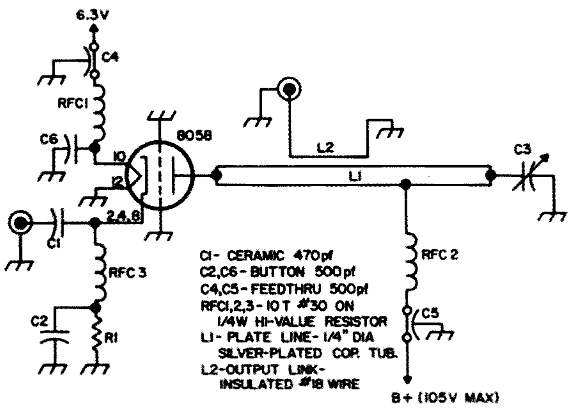


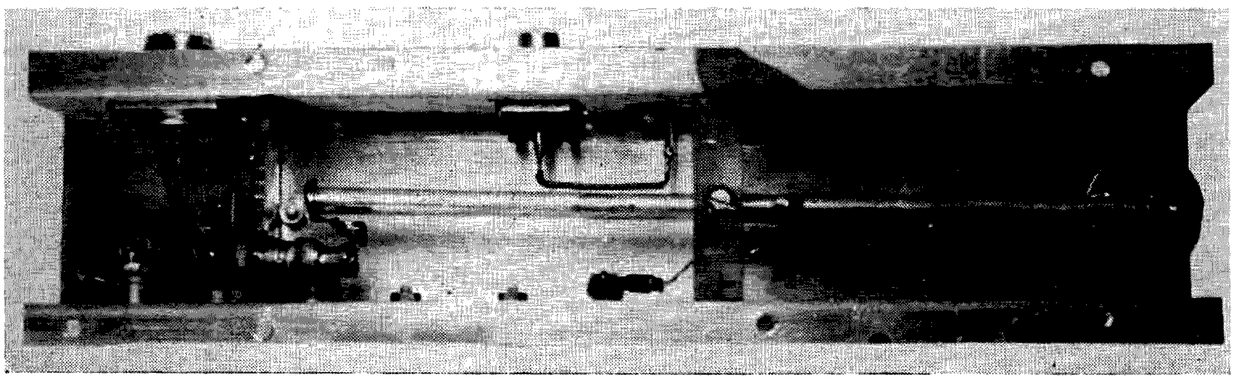
Fig. 1. Schematic of the 8058 preamp for 432 mc.

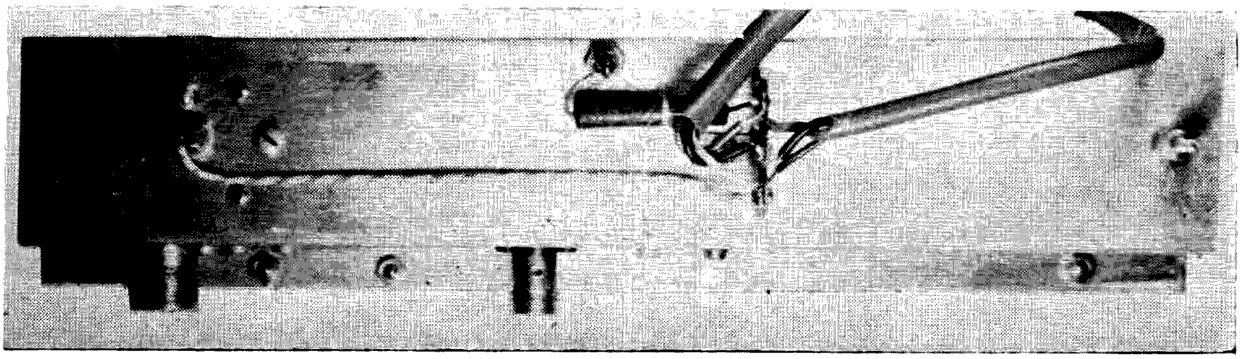
The circuit is the usual simple grounded grid amplifier usually used at these frequencies. It has an untuned cathode and a half wave plate line with link output. The grid connection of the 8058 comes out on the external body of the tube, which allows a very positive ground and ensures stable operation with no regeneration.

Construction

Aluminum was used for the external body of the preamplifier. Brass or copper would be much better since all ground connections can be soldered directly to the chassis. Cut the plate to the dimensions given, then drill as shown, and last, bend it.

Cut the partition on which the Nuvistor socket is soldered as shown in detail C. Drill


Inside of the 8058 Nuvistor preamp. C3, the plate tuning capacitor, is at extreme right. L1, the plate line, runs from the tube to C3. RFC2, the plate feed choke is near the center support and the output link L2 is just above it.



This top view of the preamp shows the output receptacle at the left with the filament bypass over it. The output jack and B+ feedthrough are in the center and the tuning for C3 at the right.

it and solder the socket in place as shown. Next, solder the partition on the body of the preamplifier. The finger stock shown soldered on the partition can be omitted with no sacrifice in performance.

The plate line is connected to the Nuvistor plate cap with a fuse clip and short strip of copper foil. This allows quick removal of the tube without disassembling the plate line.

The plate line is made of a short length of silver plated copper tubing with a copper disk soldered on one end. The line is supported at the center by a square of thick plexiglass held to the chassis with three self tapping screws. A fourth screw holds the line in place. The plate tuning capacitor is made with two copper discs. One is soldered to the line, the other to the tuning screw of a discarded coil. A standard brass screw and bolt can be used. Other details are covered in the pictures and drawings.

Operation

Let the 8058 warm up for at least ten minutes. This is the time required for the transconductance to reach its maximum. Apply plate voltage (no more than 150 volts) and connect to the converter receiver setup. Tune to the middle of the band with the receiver and put C3 at maximum capacitance. Then turn it back till you hear an increase in noise in the receiver. Next adjust the output link L2 for maximum noise. Tune in a weak signal and run an insulated screw driver down the plate line. You will find a point where the reception is unaffected by the screwdriver. This is the lowest rf point. Disconnect B+ from the preamplifier and solder RFC2 to this point. You can improve the noise figure by trying different values of plate voltage. My preamp works best with 70 volts.

. . . I1LOV

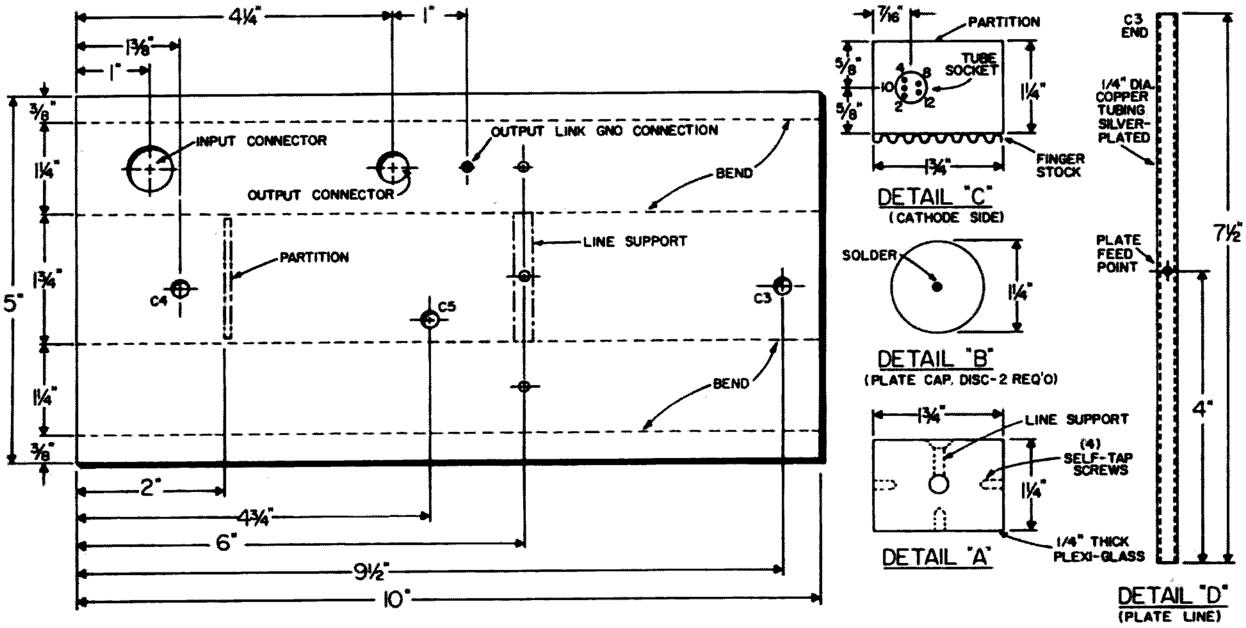


Fig. 2. Layout of the trough line and details of the amplifier. Drawings are ⅓ size.

Paul Franson WA1CCH
Peterborough, N. H.

VHF-UHF Dipmeter

50 to 600 mc with almost no work or cost

Not too long ago, I decided to make a 432 mc converter. There were very few requirements in this design. First, it had to be unlike anyone else's (a matter of pride. Anyway, their junk boxes don't have the same things in them that mine does.) Secondly, it had to be transistorized, since tubes are obsolete for this type of use, and transistors are much cheaper, easier to build with, use less power, and should have unlimited life. Thirdly, it had to be moderately simple so that I could finish it quickly. I have the attention span of a two year old and my basement is full of almost finished and unfinished (and some finished!) projects. Fourthly, it should work, if possible.

So I did some looking. I happened to talk to W1OOP, who said 2N3478's were good. Then I was down at W1BU before Sam left and he showed me a simple converter using them. So my mind was made up, and I ordered the transistors. Sam's converter used coils, but they looked sort of indefinite, as coils often do at those frequencies, and I decided to use trough-lines as in a 432 converter I saw in *UHF Berichte*, a European VHF magazine. I computed the sizes of the lines, checked and saw that they were right and built it. Then while I was waiting for the proper crystal for the local oscillator, I started to wonder if those rough lines would really tune to 432. Needless to say, none of the four commercial dip meters around here and 73 went that high. Most gave up before 200 mc, and were unsatisfactory there. So I looked around. The*ARRL*

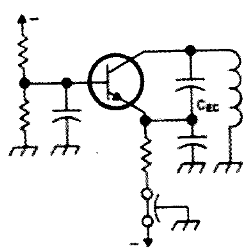


Fig. 1. Basic grounded emitter Colpitts oscillator.

Handbook had a UHF dip meter, but it uses tubes and transistors, AC line *and* batteries, not to mention *five* coils to cover 271 to 565 mc! W5AJG described a surplus conversion a few months ago, but I don't have the unit he converted and doubt that I could find one and it would be too expensive and big anyway. There was a simple UHF dipper in Sam's VHF column in *QST* a while back and it looked pretty good, as did K1CLL's, which is similar in principal (but that's about all.) So I built one, but wasn't really happy. It should be possible to improve and simplify it. So I tried. And I think I did. Here's how:

Many hams seem to think that a transistor oscillator has nothing that dips. So all the transistor dippers have used a small sampling diode and amplifier to indicate resonance. This diode can introduce unwanted dips, reduce sensitivity—and always complications.

But a little thought and experimenting reminds us that class C transistor crystal oscillators differ from tube ones in that they draw most current at resonance. Load the tuned circuit or detune it and the stage draws less current (dips). The same goes for free running oscillators. Measure the collector current and you'll get a dip when the tuned circuit is brought near another circuit tuned to the same frequency.

And that is how this simple dip meter works. It requires no amplifier, diode, tapped coil, dual capacitor or expensive components. It is a UHF Colpitts oscillator easily reaching 700 mc using a cheap ($2.06) RCA 2N3478. NPN transistor. The base bias is adjustable for variable sensitivity and the emitter current is monitored with a cheap 2 or 3 ma meter. The dip is very deep and the circuit exhibits very smooth tuning with no false dips. Here's how it works:

Fig. 1 shows a standard grounded base Colpitts oscillator. Feedback is furnished by the tap on CI and C2. As you go up in frequency,

C1 becomes smaller and smaller until the distributed and internal capacitances are sufficient for feedback.

And that's what the finished dip meter is. **Fig. 2** gives the schematic and **Fig. 3** the layout. The power components were put in a small Minibox with the meter and base bias pot. A cable runs to the rf components. They can be in another small box or on a piece of copper laminate board, as you wish. A plug-in arrangement will get you up to 300 mc, but a separate rf head is necessary for higher frequencies. Be sure to keep those leads short.

Notice that the transistor case-shield is not grounded, but is connected to the emitter to furnish a little extra capacitance that helps sustain even oscillation at the low end of each range.

I made a number of rf heads. The lowest frequency one (50 to 300 mc; could go lower) uses a 25 pf variable, a crystal socket and lots of coils ranging from a short of #16 tinned to about 20 turns. A larger capacitor would permit you to use fewer coils to cover the range, but would decrease your upper frequency a bit.

One that covers 250 to 450 mc uses a 15 pf miniature variable and the tank is a piece of copper sheet 1 cm (⅜ inch) by 10 cm (4 in.) bent into a U. I don't know the thickness, but it's the foil often used for embossing at summer camps, so you could probably get it at a hobby shop.

I made another and stuck in an old *if* can for protection and looks(?). It covers 320 to 500 mc. The capacitor is 8 pf, and the inductor is heavier copper, maybe 1 mm thick, 1 cm wide and 7 cm (2¾ in.) long. It's also bent into a distorted U. You could go higher with a smaller capacitor and coil, but since you can't reach 1215 mc this way, why bother? Incidentally, this case is resonant at 380 mc. That's the only false dip. Maybe the open construction isn't so bad.

In the two high frequency models, the inductor is soldered to the two stator posts and

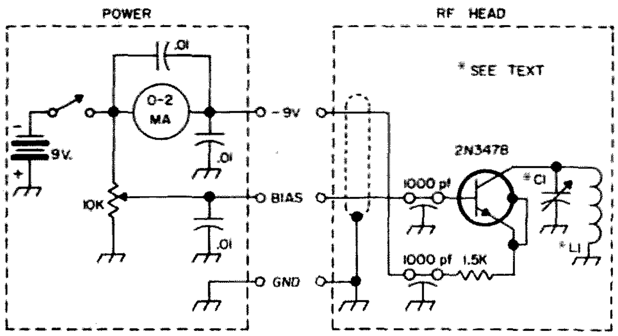


Fig. 2. Final circuit of the dip meter.

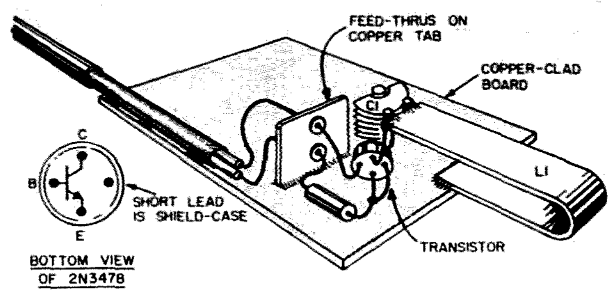


Fig. 3. Layout of the dipmeter. Note the screwy basing guide on the 2N3478.

to the PC copper. Note that the case in the higher one is just for looks. The oscillator is built on a piece of copper clad board and held in place with the variable capacitor mounting nut.

After you've finished construction, turn the base pot down and turn the power on. If the meter pins, you turned the pot the wrong way. Correct it quickly. Then adjust for about 1 ma collector current. Touch the coil with your finger. The current should dip as the oscillator goes out of oscillation. Now take your finger off and tune through the capacitor. If the current decreases more than a small amount (0.2 ma), bend the transistor a bit closer to the hot end of the collector line (stator of the variable). But don't short anything. A little experimenting with small tuned circuits, odd cavities and orange juice cans will show you that the dipper is most sensitive with small values of collector current, say 0.5 to 1 ma.

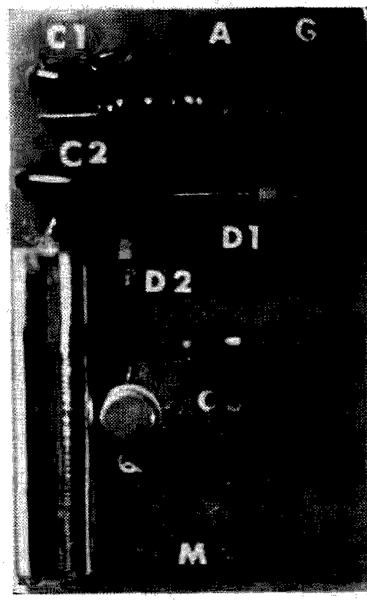
Calibration requires a little more work. The easiest way is to borrow or buy an absorption wavemeter, such as the ones made by K1CLL (Hoisington Research). Or QRM your UHF TV set. Or use lecher lines, as described in the *RSGB Handbook* or *VHF Amateur's Handbook* or almost anywhere else.

A few notes: You might be able to use other UHF transistors. I haven't tried, except with a 2N706. It worked grudgingly up to 200 mc with a smaller emitter resistor (220 ohms) and small (1 pf) feedback capacitor between the emitter and collector. The feedback capacitor (ceramic, mica or small copper tab) might be necessary on lower frequency dip meters using the 2N3478.

These dip meters are very smooth in operation and well worth the small time and few dimes required to build them. They operate as easily as a HF dip meter and are a necessity for the UHF builder. They proved to me that those trough lines were in the proper range and they can help you play around with UHF. It's a lot of fun. What are you wating for?

. . . WA1CCH

Robert Corbett W1JJL
46 Prospect St.
Torrington, Conn.



Transistorized Field Strength Meter

The unit to be described is a sensitive field strength meter that I constructed for use in tuning up some antennas that I was experimenting with.

As shown in the photographs, the unit is constructed on a printed circuit board. This makes for a small, light compact unit. Although not shown, my unit is installed in a small mini-box, with a coax connecter at one end and a regular phone jack at the other end. In use, a dipole cut for the frequency that you are interested in is connected to the coax jack and a 0-1 milliammeter connected to a long twisted pair and a regular phone plug is connected to the phone jack. The long wire on the meter is so that you can have it located where you are tuning the antenna. Did you ever try to see a meter from 100 ft. or more away?

Now to the circuit. As may be noted, there is no tuned circuit for the input. Instead an rf choke is used. Next you will note that there are two diodes and three capacitors. C1 serves to isolate the antenna, and along with the rfc makes a broadly tuned input circuit.

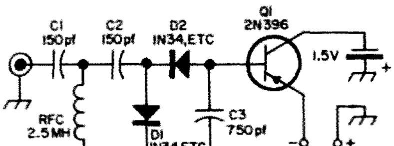


Fig. 1. The W1JJL Transistorized Field Strength Meter. A printed circuit board is available for 50¢ and a wired board for $2.50 from the Harris Company, 56 E. Main, Torrington, Conn.

C2, D1, D2 and C3 form a voltage doubling circuit that increases the sensitivity, and the transistor Q1 serves as a dc amplifier that further increases the sensitivity. From this it may be seen that a very sensitive unit is obtained with just a few parts.

Just as a sidelight; depending on the transistor that you use, the current through the meter with no signal is the leakage current of the transistor, about 0.1 ma. For this reason no zero adjustment is provided or needed.

Although I used a type PNP transistor in my unit, it is easy to alter the circuit for use with a NPN type. All that is necessary is to reverse the diodes, battery and meter connections.

With the 2.5 mh choke shown the unit works good up through the 50 mc band. I have another unit that is identical except for the rfc, that I use on the VHF bands. In this unit I use either a VHF rf choke, a different one for each band, or I connect a tuned circuit to the coax jack with the pick-up antenna link coupled to it. In this case (use of the tuned circuit) I use a 2.5 mh rfc. It is necessary to use an rf choke in all cases as it provides a complete circuit for the voltage doubler. If you leave it out nothing works.

Although construction may be done by use of tie points, I strongly recommend the use of a printed circuit as it provides support for all parts and makes for a neat unit.

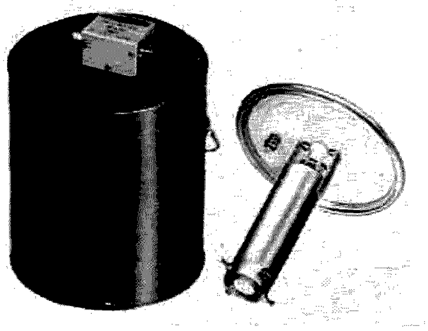
You won't find many simpler projects, or more useful ones, than this. Why not spend a few minutes on it?

. . . W1JJL

Ham Christmas Gifts

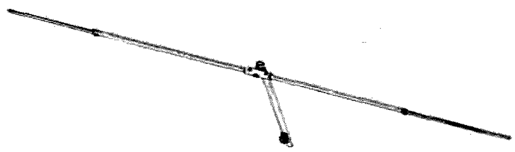
About this time each year, hams start trying to figure out how to get hammy gifts instead of the traditional ties, pajamas and socks they usually end up with. Unfortunately, unless a ham is unusually ruthless and buys his own presents, he ends up being happy with the socks. This section of gifts priced under $10 may help you a bit. Circle the most interesting ones in red and leave this copy of 73 open conspicuously for a month or so. Maybe it will do the trick.

These are some typical gifts that any ham worth his salt should enjoy. Prices generally don't include postage. If there's any question, consult a catalog or the ad in 73.



Heath Cantenna—$9.95

It's impolite, illegal and inefficient to tune up and try out transmitters on the air. You should have a dummy load. One of the best is the Heath Cantenna. It has a VSWR of less than 2 to 1 up to 400 mc, 50 ohms impedance, and can handle a kilowatt in ICAS. It's a kit that won't take you more than a few minutes to build. Heath Company, Benton Harbor, Michigan.

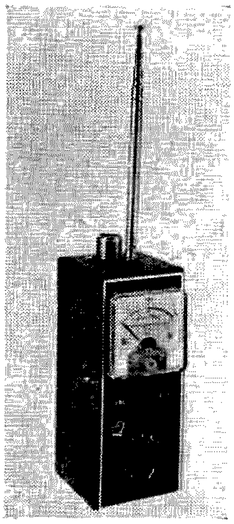


Cush-Craft Trik Stik—$6.45

The Cush-Craft Trik Stik is the universal antenna. This one lightweight low priced antenna can be mounted vertically or horizontally and the arms telescope for different frequencies. It's for CB (half wave vertical), business band, TV, CD and emergency, police, fire and other monitoring, SWL'ing, FM and hamming. Extends to 188". From distributors. Cush-Craft, 621 Hayward St., Manchester, N.H. 03103.

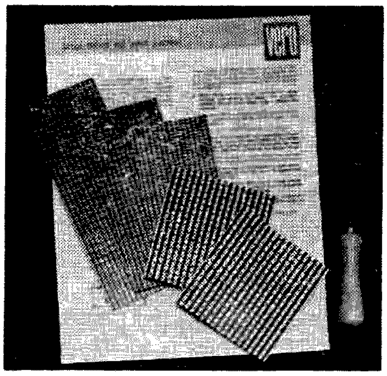
Gift Shop Tie Clasp—$3.50

Like to have *your* QSL card reproduced on an attractive durable metal tie clasp? The Gift Shop will do it for you for a very reasonable price. The card is photographed and reduced to the proper size for the clasp. The lettering is under the surface, so is protected. Gift Shop, Box 73, Northfield, Ohio 44067.



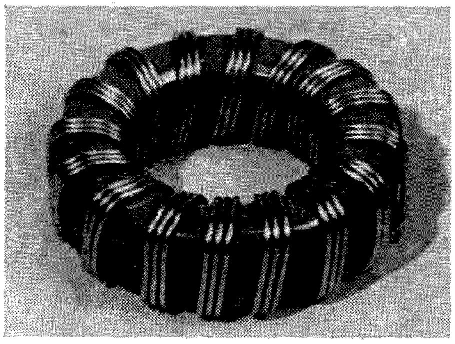
Quement SWR Bridge—$9.95

This Quement SWR bridge and field strength meter will help you get the most out of your antenna (and transmitter) at minimum price. It will take a full kilowatt and can remain in the line all the time. It's 52 ohm impedance, of course. The instrument comes complete with instructions and schematic. Quement Electronics, 1000 South Bascom, San Jose, California.



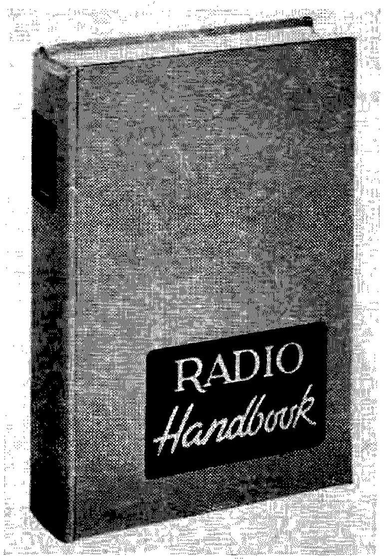
Veroboard Kit—$5.95

Any ham who builds will find this little kit very useful. It's the easiest, most convenient way to breadboard circuits I've seen. In fact, not only is it good for experimental work, but is perfect for finished projects as well. Each Veroboard is a piece of bakelite punched with a grid of holes and covered with strips of copper foil. A special tool furnished with the kit removes copper where you don't want it, and you end up with a simple-to-make printed circuit. This kit also includes six associated Veroboards and complete instructions. You can order it direct from Vero Electronics, 48 Allen Blvd., Farmingdale, N.Y.



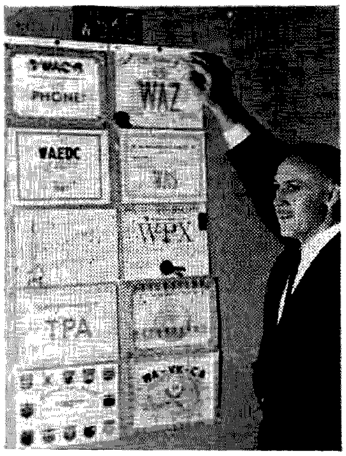
Ami-Tron Balun Kit—$5.00

The Ami-Tron toroid balun kit makes a 4:1 or 1:1 balun for use between 80 and 6 meters. It's furnished with #14 epoxy insulated wire, a two inch powdered iron RF core and complete instructions. The balun will handle full legal power. It's easy to wind, too. Takes about two or three minutes. You can buy the kit at radio distributors such as WRL, or direct from Ami-Tron Associates, 12033 Otsego Street, North Hollywood, California.



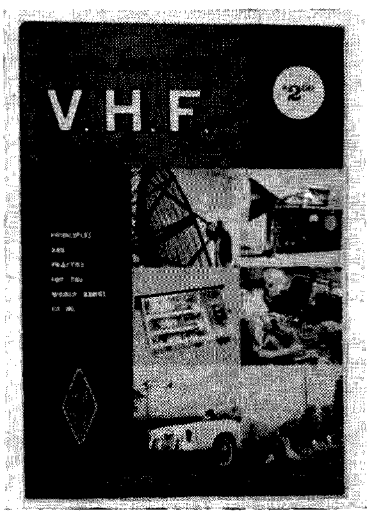
The Radio Handbook—$9.50

Most hams are familiar with this tremendous handbook. It covers practically every phase of radio theory in simplified, easy-to-grasp form. The Radio Handbook gives you the latest design and construction data. Its complete, basic information will help you design and build modern high-performance ham equipment from power supplies to UHF. Plans in the book include full details, even tips on attractive styling. It's a fat 816 pages of what you need to know. You can buy the Radio Handbook at most distributors, from 73, or direct from Editors and Engineers, P.O. Box 68003, New Augusta, Indiana 46268.



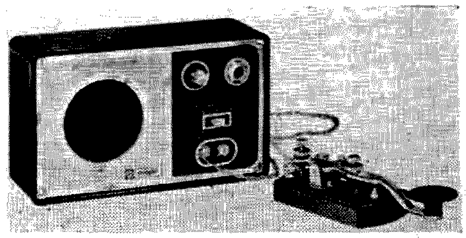
Tepabco Certificate Holders—$1

The picture of Lloyd Colvin of Berkeley, California and some of his wall paper shows us how nice they look in the new Tepabco plastic certificate holders. Certificates mean a lot of work to most of us and these holders will keep them clean and neat and display them to maximum advantage. Each one holds five certificates and a package of three holders is only $1. Ten are $3 postpaid from Tennessee Paper and Box Co., P.O. Box 198, Gallatin, Tennessee 37066.



Radio Amateur's VHF Manual—$2.00

Any VHF'er or prospective VHF'er should have this excellent handbook by W1HDQ. It gives you a brief history of ham VHF activity, then goes into almost all of the nooks and crannies of the VHF and UHF world for a look at theory and practical construction. As they say in the ad, "It deserves a place on the bookshelf of every amateur . . ." A tremendous bargain at $2. It should cost twice that. From QST in Newington, Conn. 06111.



Knight LC-1 CPO Kit—$7.95

Know someone who'd like to become a ham but hasn't learned the code? Maybe your wife or children or a neighbor? This Knight-Kit Code Practice Oscillator will help you help them. It's a modern two-transistor oscillator with plenty of volume for group practice, plus a jack for private listening with head phones. The kit will just take a couple of hours to build from the complete instruction manual. It comes complete with key and battery. Allied Radio, 100 N. Western Avenue, Chicago, Ill. 60680.

Epsilon Code Records—$9.95

One of the best ways to learn code is the system used in this album. It's based on modern psychological techniques and is said to take you to 13 wpm in less than half the time usually required. Epsilon Records, 206 Front Street, Florence, Colorado.

And others—

There are plenty of other gifts under $10 that any ham would like to receive. How about a 24 hour clock, such as the attractive Mastercrafters 2324. Or an impressive Hy-Gain "On the Air" sign? Ungar makes a nice Technicians Soldering Kit for about $3.50; give a new ham a decent soldering instrument so he'll start out right. A builder likes to keep records of what he's been doing and an electronics template is helpful for neat work. Moody makes a nice assortment of miniature tools, such as a set of taps for 0-80 to 4-40 screws. Dymo tapewriters are awfully useful and they seem to be getting cheaper each week. A specialized set of tools for hams is radio tap and dies. Nutdrivers are nice for those who don't have them. And how about small parts cabinets? Who *doesn't* need them? Finally, how about a pound of Ersin 5 core, 60-40, 18 gauge solder? Most of these gifts are available from any large wholesaler or mail order distributor. Some may be a bit off-beat, but all would be useful and fun for a ham. Merry Christmas. WA1CCH

Building and using a Q-meter and impedance bridge.

RF Measurements

Jim Kyle K5JKX
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Oklahoma City, Okla.

Any ham who builds equipment (and if you don't, why do you read 73?) has frequent need to measure the characteristics of things. DC measurements are simple; ac measurements in the audio range aren't too difficult—but when you get up into rf measurements, the picture changes.

Most of us have a grid-dip oscillator which lets us measure the frequency of a resonant circuit, and not quite so many of us have vtvm's for use at dc and the audio range—but that just about ends the list of rf measuring devices in wide use among hams.

Two other gadgets, costing about $5 each to build, can extend our measurement techniques in the high-frequency range to approximately equal those available to us in the audio area. And strangely, though these gadgets were described in print at least 10 years ago, they seem not to have caught on! Maybe it's not so strange at that—the gdo lay ignored for some 20 years from its first description before gaining its present popularity.

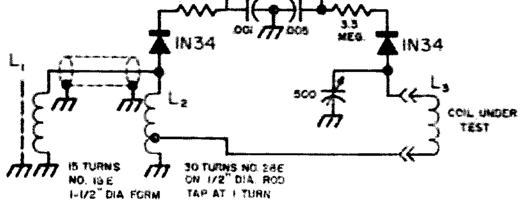


Fig. 1. Shematic of Q-meter.

Anyhow, the two gadgets are a Q-meter and a resistive impedance bridge. The Q-meter allows you to make direct measurement of inductance and Q on any coil, at any frequency you like in the 3-30 mc range, while the impedance bridge allows you to measure the resistive impedance of anything you like within the same range of frequencies.

Though inexpensive to build, both devices are every bit as useful as elaborate laboratory equipment. Their accuracy will be as good as you make it—but can easily approach that of any similar devices.

Both require a gdo or similar low-power signal source, and a vtvm. We assume that if you're interested in rf measurements, you already have both.

Interested? Let's see how they're built first, then how to use them. We'll start with the lesser-known Q-meter.

The Q-meter, first described by Elbert Robberson W2FRQ, in 1954, determines the Q of a coil by measuring the voltage developed across the coil in comparison to the voltage fed into the coil in a parallel-resonant circuit. By definition, the Q is equal to the ratio of the parallel voltage compared to the series voltage.

The schematic appears in Fig. 1; typical layout is shown in Fig. 2. Only a few points are critical—aside from them you can vary things to suit yourself.

The first critical point is that the coil being tested must be supported in the clear, with no metal or other objects in its field. In the original model, this was accomplished by placing the test terminals on the far end of 1½ inch

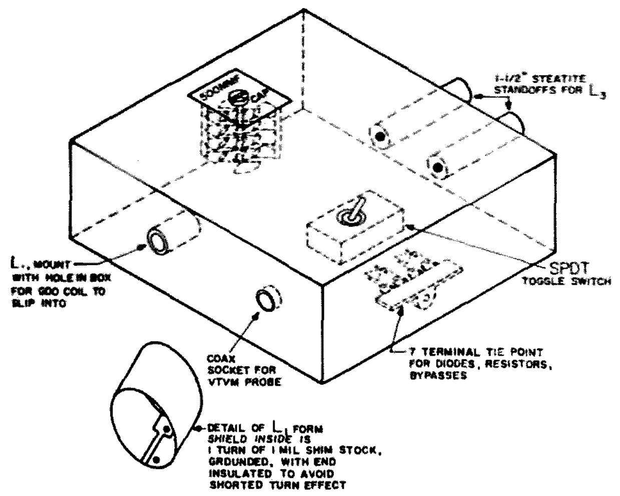


Fig. 2. Suggested layout of Q-meter.

ceramic standoff insulators, and putting them on the far side of the case from all controls, as shown in Fig. 2. Any position in the clear and far enough from controls to eliminate hand-capacity effects is suitable, however.

A second critical point is the use of a Faraday shield between the gdo and the coupling coil, L1, together with coax cable from L1 to L2 in the Q-meter. These eliminate the probability of direct coupling between the gdo and the coil under test, so that any voltage measured across the coil you're testing must be that developed by the series voltage fed in. The shield consists of a strip of brass shim stock insulated on one side with Scotch tape so it won't form a shorted-turn, and fitted inside the coil form for L1. It is grounded at one point only.

A third critical point is the apparent duplication of components in the rf voltmeters made up of the two diodes. Don't try to economize by using a single diode and switching rf. This will cause varying loads on the circuitry, and will reduce the accuracy attainable. As shown, all circuits operate with constant loading effect, and switching the VTVM has almost no effect at all.

The final point—not so critical but important nevertheless—is the location of the tap on L2. With the tap at 1/30 of the total number of turns, the actual series voltage will be just 1/30 of that measured in the "Set" position. The tap *must* be at one turn, but the total number of turns can be increased to 50, say, to change the series voltage to 1/50 of that read.

Naturally, all leads should be kept as short as possible, consistent with proper separation of coils. Total shielding is recommended, and occurs automatically if a metal box is used.

Assuming that you've built the gadget as shown and without change, here's how to use it. First, the dial of the capacitor should be calibrated. The simplest way to do this, if you have access to a capacity meter, is by direct measurement and marking. Otherwise, you'll be fairly close to simply subtract the minimum rated capacity of the unit you use from the maximum value and divide the resulting capacity range by 10. Then mark off a semi-circle in 10 equal 18 degree segments. and mark the lowest one with minimum value. Add the figure you got in the division to this and make that the second point; follow this same routine until you reach maximum capacity.

This calibration is used primarily to measure inductance, by substituting the capacity setting required for resonance and the frequency at which resonance occurs into the formula: 25,330 equals L times C times f^2, where C is in mmfd, f is in mc, and L is in microhenries.

To measure Q, let the gdo and the vtvm warm up, then set the Q-meter switch to "Set" and adjust the coupling between gdo and Q-meter until 0.3 volts is indicated on the vtvm. (You are actually adjusting to put 1/30 of this, or 0.01 volts, into the coil under test.) Next, switch to "Read" and tune the capacitor for maximum reading. When you have it, switch back to "Set" and check to make sure you still have a reading of 0.3. This will usually change, due to increased coupling at resonance. Re-adjust coupling for the proper reading. Now switch back to "Read" and multiply the figure you read by 100; the answer is the Q of the coil! It's that simple.

If you have changed the size of L2, for instance, so that you have 50 turns instead of 30 the procedure would be the same except that your reading on "Set" would be 0.5 rather than 0.3. The 1/50 voltage division provided by the tap would give you 0.01 volts applied

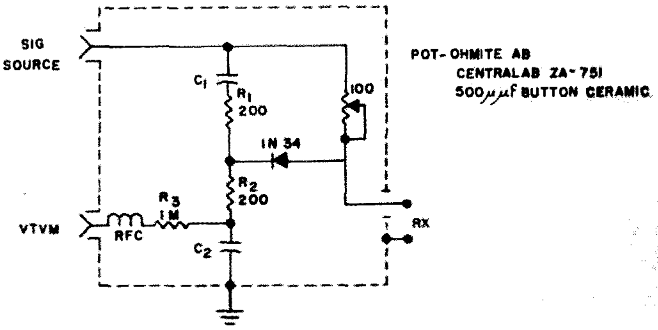


Fig. 3. Schematic of Impedance Bridge.

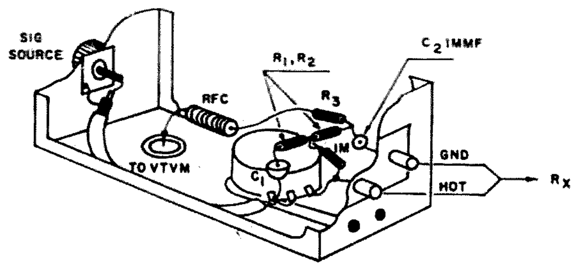


Fig. 4. Cutaway showing parts location.

to the coil, so the rest of the operation would be the same.

No harm to readings will result if you switch ranges on the VTVM between "Set" and "Read" provided your VTVM is accurate on both ranges used.

Now let's look at the impedance bridge. This device was described, also in 1954, by Wil Scherer of "TNS" fame. Incidentally, a complete kit of similar design has been available from Allied Radio for several years.

The schematic of the bridge is shown in Fig. 4, with layout in Fig. 5 and detail drawings for drilling of the box in Fig. 6. In this device, physical layout is highly essential to success and no changes are recommended.

The bridge itself is similar to a conventional Wheatstone bridge, as the schematic shows. The major difference is in the location of the indicating meter.

When the resistance of the unknown under test is the same as that of the variable resistor, no voltage will appear across the diode and as a result there will be no dc across C2. However, until the bridge is balanced an rf voltage *will* appear across the diode and be rectified. If either Rx or the signal source form a complete circuit for dc, the rectified voltage will appear across C2 and can be measured by the external vtvm. Since in normal practice the signal source will be a gdo through a coupling loop, this requirement of a dc path will be met.

For the instrument to operate properly up to 30 mc, it is important that no substitution be made for the Ohmite AB pot employed for the variable. Ordinary volume controls have too much stray capacitance for use here. With the AB, passable results can be attained up through 54 mc.

Resistors R1 and R2, similarly, must be composition units and should be perfectly matched. The exact value is not so important as long as both are of the same value; an ohmmeter check is satisfactory. The same matching requirement extends to CI and C2; if operation above 30 mc is not intended, it would be best to use 2 per cent silver micas here. However, for operation at higher frequencies the button-type ceramics are necessary, so matching with a capacity meter is the only way out.

The only really critical point in the construction of the impedance bridge not evident from the drawings is the mounting of the variable resistor. It is mounted on a ¼ inch block of polystyrene, which in turn fastens into place by means of two 6-32 tapped holes. The pot must be clear of the shield since all terminals are hot with respect to the case; this is why the ⅜ inch hole for the shaft, also. And naturally, don't use a metal knob!

To calibrate the dial, connect an ohmmeter between the "hot" Rx terminal and the center conductor of the coax input terminal. Mark the scale at 0, 10, 20, etc. ohms as read on the ohmmeter; subdivide at as small an interval as you wish.

To test the instrument, couple a gdo to the input terminal (a convenient shielded coupling cable is shown in Fig. 6) and connect your vtvm to the meter jack. Connect a 47-ohm composition resistor to the Rx terminals, using the shortest possible leads, and set the gdo to some frequency below 20 mc. Adjust the knob of the impedance bridge until you get a definite, sharp null on the vtvm. Ignore the gdo meter. The null should be very close to 47

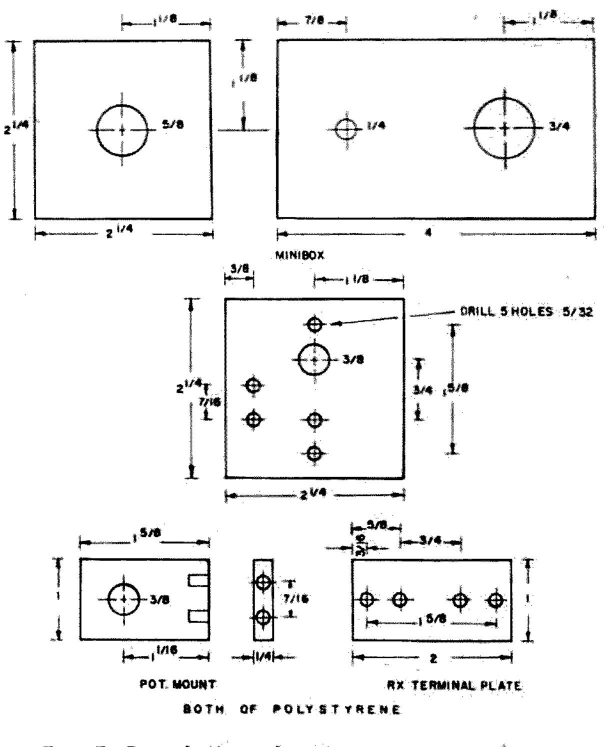


Fig. 5. Box drilling details.

ohms on the dial (within the tolerance of the resistor used). If no null can be achieved, check for errors.

If you get a good null, increase gdo frequency until you can no longer obtain a complete null. The frequency at which this occurs should be somewhere above 60 mc if built as described, and somewhere above 30 mc if silver-mica capacitors are used. Wherever it occurs, it marks the upper limit of frequency for your instrument to give accurate readings, although relative readings can be achieved at any frequency at which even a partial null can be obtained.

In use, the unknown impedance is connected to the Rx terminals and the gdo set to the desired frequency. Then the nob is varied for a null. When null is reached, check the gdo meter to make sure you have a true bridge null and not just a loss of power from the gdo, then read the resistive impedance from the bridge dial.

Like any other resistive-impedance meter, this will not give accurate results if reactance is present in the unknown. However, for most antenna and receiver measurements, this is no disadvantage as any reactance present can be tuned out before measurement.

Now that we've built our two rf-measuring devices, let's look at some uses for them.

The straight measurement of coil Q of course is an obvious use for the Q-meter—but how about using it to find the optimum coupling point for a transmitter output tank?

To do this, set the Q-meter capacitor to the same value you will use in the transmitter, and prune the coil to resonance. Attach the coupling coil, and connect a 47 or 51 ohm composition resistor to the coupling coil to substitute for the antenna. Now measure coil Q. As you vary the coupling of the antenna coil, Q will vary over a wide range; for most uses, you want a reading of 15 to 20. When you get the proper Q value, make the coupling adjustment permanent. That's all there is to it.

The impedance bridge is a natural for measuring the input resistance of antennas; simply connect it through a half-wave line to the antenna and take your reading.

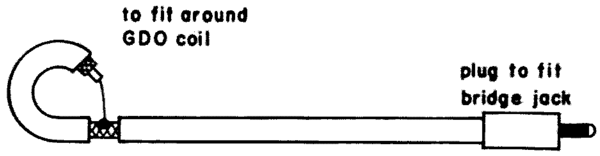


Fig. 6. GDO coupling cable.

But it also comes in handy for preparing the half-wave line to start with. Make a coupling loop at one end of your length of coax and measure off a free-space half-wavelength down the line. Don't cut it—stick a pin through to short the inner conductor and shield together temporarily. Set the bridge dial to 0, and start moving the pin toward the bridge end of the line. Somewhere about 2/3 of a free-space half wave, you'll find a null point on the bridge. This is your electrical half wavelength. Cut here and you have it. Any integral multiple of a half wave can be located by the same technique.

To measure a quarter-wave line with the bridge, you have to cut the coax since an open-circuit at ¼ wave reflects as a short to the bridge. You can start by measuring a half wave, then dividing it in half and adding six inches or so. Trim off the far end only about an inch at a time until you reach the null point, which will be your quarter wave.

This impedance bridge measures only in the range 10 to 100 ohms; to measure unknowns outside these limits the inverting properties of quarter-wave lines may be used. This is best illustrated by an example.

Let's assume you want to measure the impedance of a voltage-fed antenna at 21 mc. You know to start that it is in the neighborhood of 2000 ohms. First measure off a quarter wave of 300 ohm twinlead. Use this to connect the impedance bridge to the unknown. When you get a null, the relationship of the dial reading to the true value of the unknown will be dial/line equals line/true; thus, with 300 ohm line, if you get a null at 90 ohms on the dial you have 90/300 equals 300/true, which may be solved to get a true value of 1000 ohms. Had the null occurred at 60, the true value would have been 1500.

. . . K5JKX

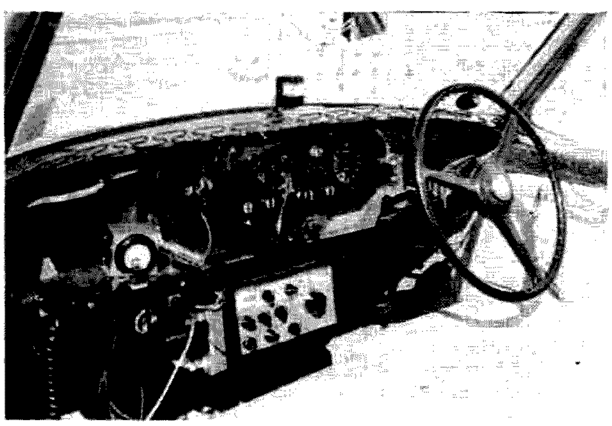
Edgar Wagner G3BID

International Licensing in the Belgian Rallies

The Belgians were probably the first to organise truly International Mobile Radio Rallies giving temporary mobile licences to all Amateurs, irrespective of whether their country gave reciprocal facilities to the Belgian Nationals, or not.

It began in April 1963, when an International Rally was organised by the newest and smallest section of the Belgian National Radio Association U.B.A. by ON4PL in Verviers near the Dutch and German frontiers. Licences were obtained from the Belgian authorities for all participants to operate in Belgium for a week.

This Rally was so successful that the second rally was organised in September 1963 by the headquarters of U.B.A. in Brussels in close co-operation with the Belgian Red Cross Society to celebrate the Centenary of the Red Cross.



The installation in ON5ZE/M-G3BID/M's Bentley.

At the opening of the rally, ON4VY was able to announce that the Belgian Government had agreed to grant temporary mobile licences to foreign Amateurs for short periods at any time irrespective of whether there was any organised rally taking place at that time.

On questions of International licences Belgium is far ahead of all other countries, and their rallies are becoming regular events.

Last year two International Mobile Rallies were organised in Belgium, and so arranged as to take place on successive weekends so that foreign visitors to Belgium could participate in both rallies on one trip.

The first took place on the 29th and 30th August in the Ardennes and was organised by the Province of Luxembourg section of the U.B.A. (This must not be confused with the Grand Duchy of Luxembourg–LX, which is not prepared to grant licences unless reciprocal facilities exist). This then was organised by the Province of Luxembourg section of the Belgian Club U.B.A. and took place, of course, entirely on Belgian territory.

The rally took place at Nisramont in one of the most beautiful parts of Belgium. The rally was organised on a two day basis, the first day being entirely informal and was designed to allow the various participants to meet each other, examine one another's installations, discuss radio problems and generally meet on a social basis. The organisation was quite remarkable. Everything which the mobile Amateur could desire was available.

Next to the rally site was the Hotel Rochers du Herou where those who wished to spend the night in a hotel could obtain accommodation and, of course, meals and refreshments were available at all times.

For those who prefer to camp or bring caravans, adequate parking space was provided and tents were even available for those who wished to take advantage of them. These were provided by the Belgian Red Cross, and it should be stressed that complete co-operation existed throughout between the Radio Society U.B.A. and the Belgian Red Cross who greatly contributed to making the event so successful.

A large tent had also been provided as a meeting place in the event of bad weather. But the weather remained perfect throughout.

Thus many mobiles turned up on the Saturday and met one another and generally had a most enjoyable party.

On Sunday the competitive part of the rally was due to begin at approximately 13.30 local time on 3.5 mc and 144 mc.

Here one of the most remarkable pieces of organisation was witnessed.

The rally organisers had laid on a three-course lunch, hot soup, hot chicken and two vegetables and a sweet for about 300 persons. A delicious meal it was too. This was a feat of organisation we had not expected and was due to the co-operation of the Belgian Army with Radio Club and the Red Cross. This meal incidentally was free and was included in the modest subscription fee of 100 Belgian francs which also included the third party insurance which is compulsory in Belgium for all rallies of this nature.

The competitive element of the rally was divided into two groups—the 80 metre group and the 2 metre group.

The vehicles left the headquarters at intervals and after passing the first rally sign had to contact their control station before passing the second sign. These signs were at 4 kms and 8 kms from the control. After exchanging a message, the competitors had to proceed to the first control point. Here a few questions had to be answered on a questionnaire before proceeding to the second control point.

Between the first and second control point, stations had to make 4 QSO's with other mobile stations who had passed the first control point, and exchange numbers which they had received in their envelopes. Here one was, of course, free to use any frequency on the band on AM or SSB at one's own choice and QSY'ing about the band was very much the order of the day.

At the second control point, a further series of questions mainly concerning articles of radio

Some of the cars at the Ardennes Rally.

equipment in shop windows of the town of Bastogne.

And so on to the next control with more radio contacts.

Complaints had been heard of some rallies in Europe that the competitors found them too difficult. On this occasion, this could not be said. The competitive part of the rally was generally very easy and, in fact, the judges had much difficulty in deciding the winner.

This is a good thing. The rallies need not be difficult to be enjoyable: in fact, most people come to meet their fellow amateurs, to see their equipment and talk about their experiences, especially when these rallies are of so international a nature as this one was, with members from Belgium, Holland, America, France, Germany and Britain.

We would like more of these rallies which do not overstrain one's capabilities and, therefore, result in a really relaxed and friendly atmosphere.

After the return from the excursion we reassembled at the rally site and the prizegiving took place. The Prince of Merode, the Governor of the Province distributed the prizes.

And so a very enjoyable party ended.

The other rally centred around Bruges.

Bruges is one of the most lovely towns in Belgium with its beautiful old buildings, its magnificent belfry, its canals, its churches and its museums. But clearly to make the rally itself meet in Bruges would be highly unsatisfactory as the town is congested enough as it is and to throw a further burden on the already congested town would be undoubtedly highly unsatisfactory.

The countryside around Bruges is quite different from that in the Ardennes and is generally flat and the interest does not centre so much on the countryside as on the interesting little villages, churches and other curious and interesting places around.

The rally organisers fully realising this,

therefore, organised a different type of rally. It was not going to meet in Bruges itself. The rally assembled at the restaurant on the end of the Mole at Zeebrugge. Here there was a restaurant which provided meals for those who wanted them.

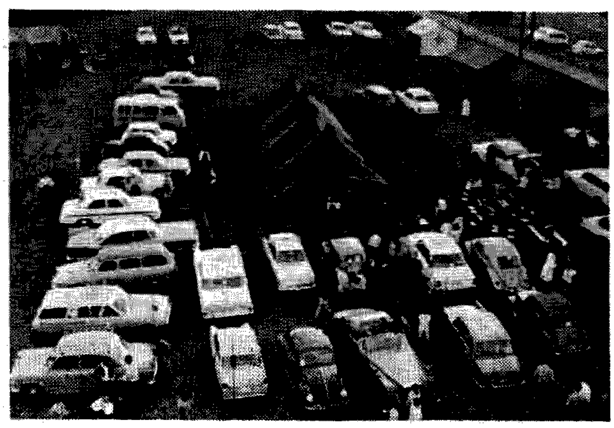
As usual the rally was divided into 80 metre and 2 metre groups and each participant received an envelope which contained the rally instructions, a Michelin Map of the area, and two sealed envelopes only to be opened in case of emergency.

The vehicles were to contact control station which was located in Bruges at 2-minute intervals. Watches were synchronised and every station given the exact time he was to call the control station. Control station then gave each participant a group of code letters which correspond with an instruction contained on the instruction sheets in the envelope. These instructions told the competitor where to go and to carry out an inspection of some interesting object and answer a question or two.

This method enabled the competitors to be sent off in different directions and dispersed over the country side and not concentrated in one place. This avoided any congestion which might be caused by the rally proceeding altogether. It also provided a test of communications. The QRM on the 80 metre band, for example, was very heavy. Various other stations not in the rally kept on turning up on the rally frequency and skip conditions being quite long all sorts of unexpected stations would cause QRM. It also required a certain degree of map reading though this was greatly assisted by the maps with which we had been provided on which the various points we were to go to were marked.

This operation must have taken the organisers a great deal of time and a lot of work.

This method of running a Rally enables the organisers to show their visitors all sorts of



View of rally site with cars returning after the contest.

interesting parts of the country which they would certainly otherwise not have seen. My own particular route included a tour of a tower used for hanging people in the Middle Ages:

We had to find out the purpose of the tower by questioning the local population.

An 11th century font in a church: an inn with some 197 beer mugs hanging from the ceiling, and numerous interesting points, as well as the club shack of the Bruges club.

Every 25 minutes on the dot we had to call control station again and get fresh instructions. In all 10 contacts had to be made with control station giving 9 different instructions, the 10th being to congregate at the finishing point which was a restaurant called "Le Lac" at Loppem, where prizes of a very generous character were distributed.

Thus, in one week we had two rallies of very different characters in different parts of Belgium but in between the two rallies before the rallies and afterwards, we were all, of course, free to use our Belgian licences on all bands permitted in Belgium.

In this connection it should be noted that 160 metres is not permitted in Belgium.

Fortunately, the 20 metre band was in very good form, and it was good fun to work DX from the car with the Belgian Call Sign during the two weeks in Belgium. I worked all continents from the Mobile Station and about 40 countries, including—JA1: KR6: UA9: 9M2: 9K2: VK2: ZS4: UL7: UO5: plenty of W's and VE's including a VE7 as well as a large number of European stations, of course.

The pleasures of operating a mobile station in a foreign country are really considerable, not least of which is meeting the locals and, in Belgium, their hospitality was tremendous.

ON4VY took us to dinner in Brussels to a mussel meal. Brussels is famous for cooking mussels in dozens of different ways. The mussel meal in Brussels will long remain in our memories.

For the rally in the Ardennes I chose to stay at La Roche en Ardenne. Here too the cooking was of quite an extraordinary high order.

We met many friends who we had originally met on the first International Rally at Verviers, including its organiser—ON4PL; that great German mobile operator—DL1KN: that French mobile enthusiast—F8TH, who had succeeded this time in bringing the Secretary of the French Club, REF,—F9OE with him.

Several Americans in France or Germany turned up at the Ardennes Rally, including —K3JOH/DL414: WØAJW/F7EN: K1ECT/DL4HU. . . . G3BID

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A New Two Meter Hetrodyne Exciter

Use a suppressor balanced mixer to get on two

While SSB is becoming widely accepted on the high frequency bands, AM still reigns above 30 mc. Drift is the foe of VHF SSB since both transmitters and receivers have to stay within 100 cycles to be of any use. Lack of stability is one of the greatest factors keeping HF SSB men from enjoying SSB on VHF in spite of its many advantages.

But drift can be conquered. Conventional techniques for VHF call for multiplying a fundamental many times to the required band. This obviously multiplies drift many times, too, so that most HF vfo's are unsatisfactory on two and above. But the method of changing SSB frequencies is heterodyning. This additive process keeps the drift down to reasonable levels. High quality overtone crystals for this process are now available at low prices. In fact, you can often borrow a little oscillator injection from your receiving converter.

Frequency generators and mixers

When used as frequency converters, modulators are more commonly called mixers. A broad classification of mixers is into balanced and unbalanced types. These can be further divided into efficiency and power (brute force) mixers. Balanced mixers provide suppression of the carrier and excellent distortion figures. However, they are a little more complicated than unbalanced ones.

Brute force mixers are rarely used in practical heterodyning equipment because of the high power requirements. Efficiency mixers are much more common. Various schemes of modulation have been tried in mixing—grid, screen, cathode, grounded screen. Each has its merits and demerits:

grid: low drive and modulation requirements but low output.
screen: high output but high screen current.
cathode: good output but low plate efficiency.
Grounded screen: low screen current and good quality but low efficiency.

One form of mixer which has not seen much use in the HF and VHF bands is the suppressor modulated pentode. While it is true that screen current can run higher than normal because of the negative bias on the suppressor grid, this type of mixer possesses excellent quality, stability and overall efficiency. Drive required is very small. Because the suppressor

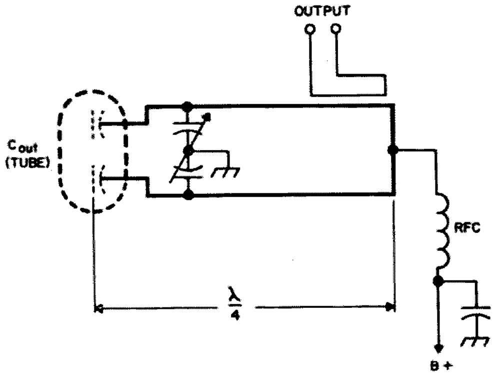
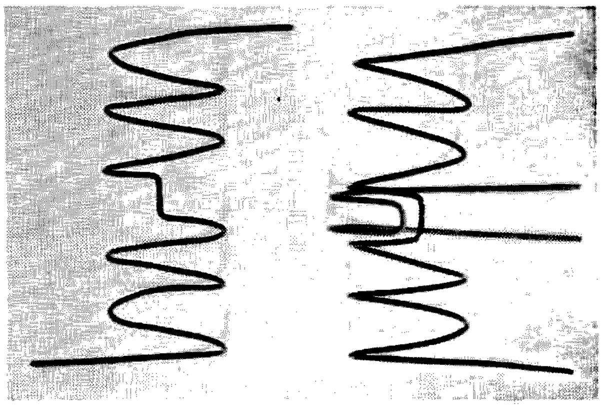


Fig. 1. Typical quarter wave tuned circuit. The quarter wave line can be rolled up as in the balanced tanks in this transverter.



Standard center tapped coil on the left. The folded tuned (quarter wave) line is on the right. Note how the pitch reverses at the center and how coupling is achieved. L7, L12 and L13 are made in this manner.

has a negative bias on it the modulator need supply only voltage in most cases. Plate efficiency can run as high as that of the same stage operating in class B. Quality is excellent through high percentages of modulation. The rest of this article will describe a two meter heterodyne exciter using a balanced suppressor mixer.

In recent experimenting with a 50 mc mixer, I came across a very attractive circuit using the 6BU8.[1] This tube is designed for combined sync separator-clipper and AGC in television receivers. Nevertheless, it does an excellent job as a balanced mixer for ham applications. The basing leaves a lot to be desired, but the layout I used provided excellent results with no cross socket shielding. The 7360 could possibly be used in this circuit since its maximum operating frequency is above 100 mc. The major advantage of the 6BU8 over the 7360 is its relative tolerance to magnetic fields. The 6BU8 can't be mounted on the filter choke in your power supply, but it does not need the extensive shielding required by the 7360. Incidentally, the 6HS8 is very similar to the 6BU8.

Circuit details

Briefly now, an explanation of the operation of this unit. V1, the 6AB4 (or half a 12AT7) is a standard third overtone oscillator at 41 mc. The 51 k grid resistor was chosen for good output with best stability and a minimum of crystal current. V2A, the triode section of the 6AU8A, triples the 41 mc output of the oscillator to 123 mc. V2B, the pentode section, operates as a class C amplifier and supplies ample drive for the mixer. This amplifier also provides isolation from the oscillator string and furnishes an extra tuned circuit for cleaner drive.

Grid number 1 of V3, the 6BU8 mixer, is fed with the 123 mc local oscillator signal. The 21 mc from your SSB or other transmitter is fed push-pull through the L4, L5, C4 network into the suppressor grids. The 144 mc sum signal is selected by the push-pull plate tank L7, C5 and coupled to the grid of the class A 6AK5 driver, V4, through the two L8's (oops), and C6. Again, an amplifier is used to insure a clean signal and sufficient drive to the following stage. The output of the driver is then applied in push-pull to the grids of the 6360 final. Output is about 10 watts PEP or 4 watts of carrier depending on what you feed to the suppressors of the mixer.

With 225 volts on the plates, the output of the final is sufficient to drive a pair of 4CX300A's to full input. The quality of the

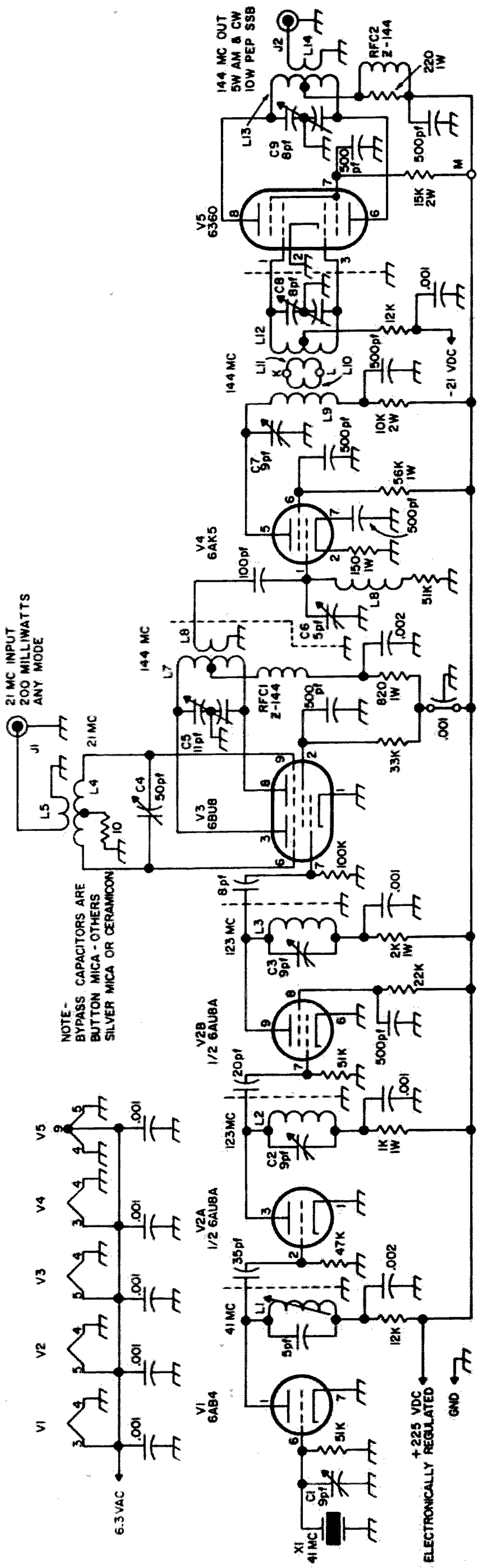


Fig. 2. Schematic of the Two Meter Heterodyne Exciter. 200 mw at 21 mc gives you 10 watts PEP output on 144 mc. For layout and shielding details, refer to the photographs.

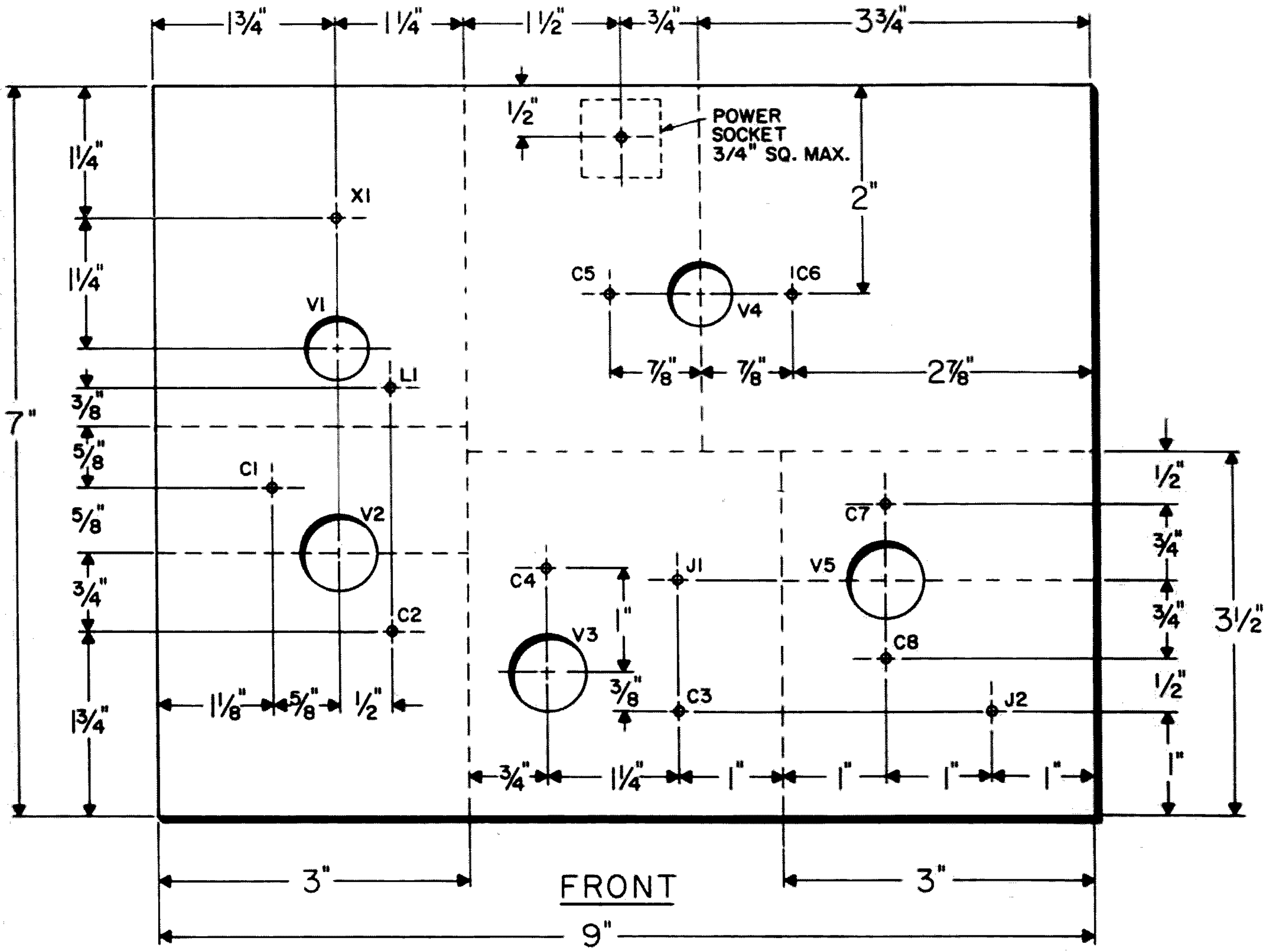
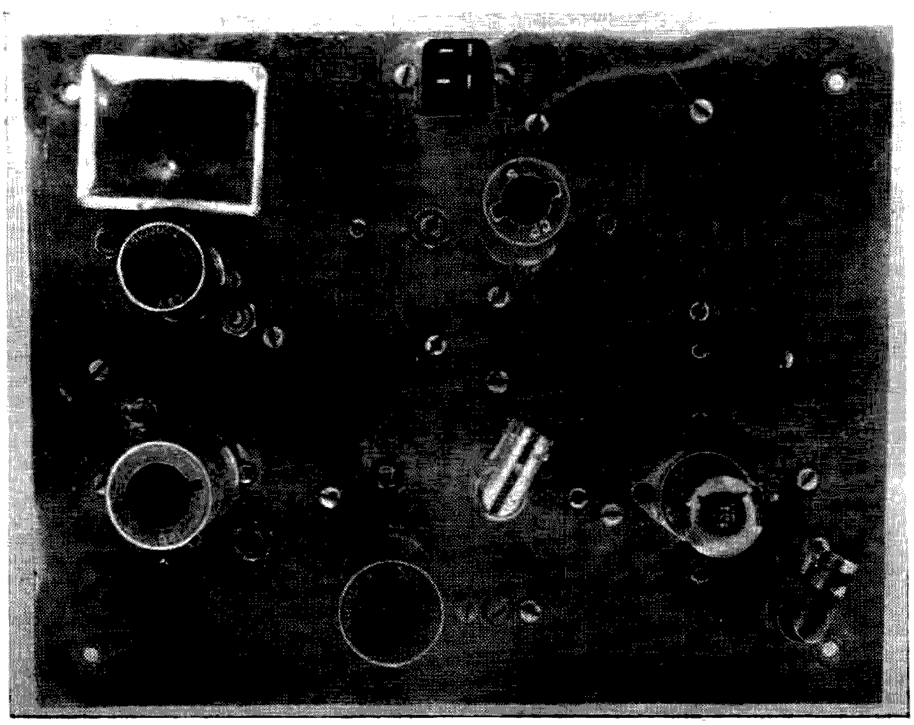
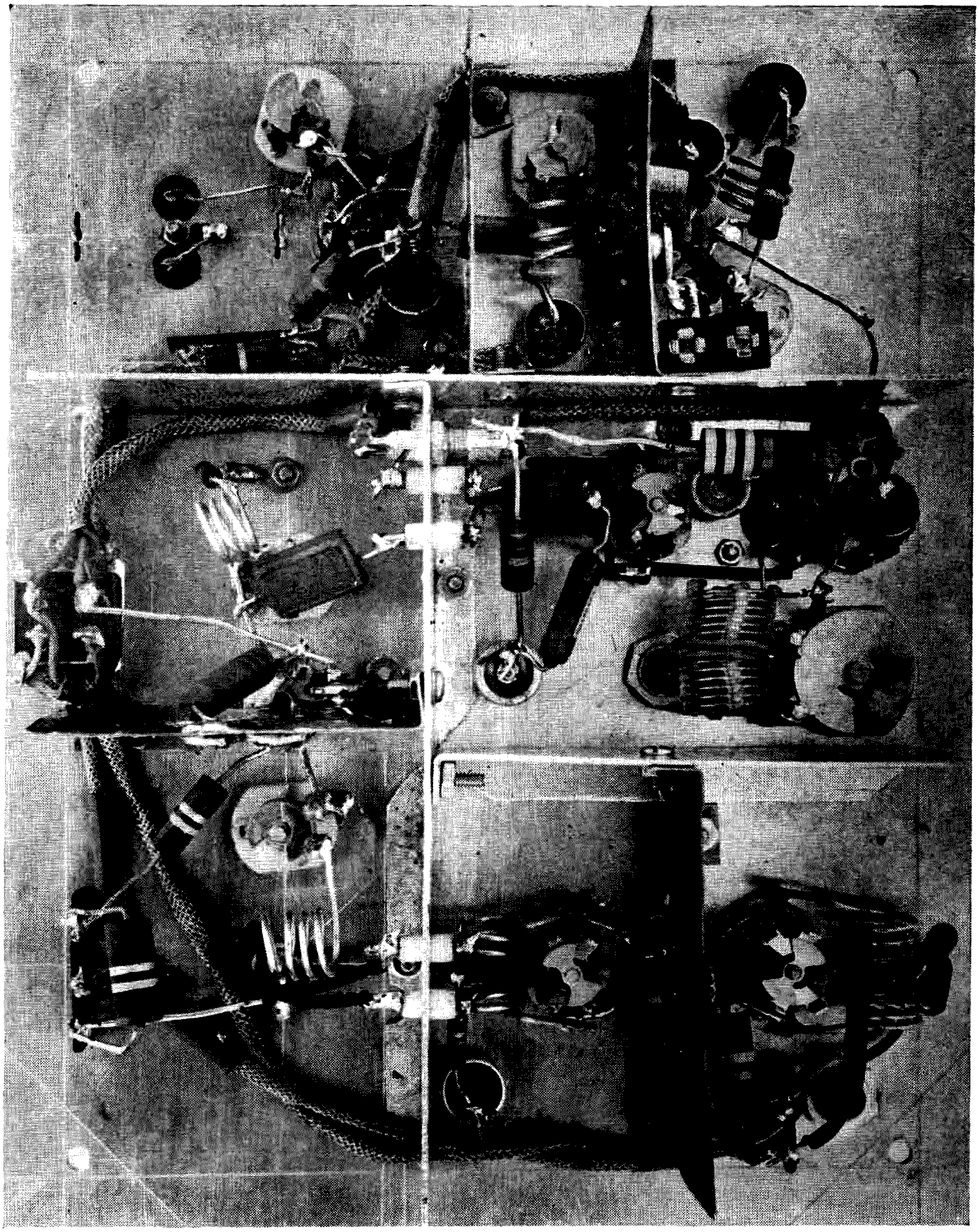


Fig. 3. Half size drilling template for the 144 mc transverter. Small circles only locate mounting centers. The dashed lines indicated shielding. The unit was built on a 7 x 9 inch aluminum plate which was bolted to a 7 x 9 x 2 chassis.



Top view of the exciter. Counter-clockwise starting at the top left are crystal, V1, V2, V3, J1, V5, J2, V4 and the power plug.



Bottom view of the exciter. Wiring is not too neat but it is in keeping with good VHF practice and gives a good idea of the parts placement. Top left hand section is the 6AB4 41 mc oscillator, middle top is the 123 mc output of the 6AU8A tripler. Top right is the output from the 123 mc amplifier, which feeds into the 6BU8 mixer below. Output of this mixer goes to the 144 mc input of the 6AK5 amplifier on the middle left. The plate circuit of this 6AK5 is in the lower left. It is link coupled to the grid of the 6360 final in the bottom center. The output of the 6360 is in the lower right to a BNC.

Table 1 Voltage Chart

Tube Pin	*V1 6AB4*	*V2 6AU8A*	*V3 6BU8*	*V4 6AK5*	*V5 6360*
1	+115	0	0	0	−21
2	0	−0.15	+165	+1.25	0
3	6.3 vac	+220	+225	6.3 vac	−21
4	0	0	0	0	0
5	0	6.3 vac	6.3 vac	+160	0
6	−3	0	0	+100	+225
7	0	−1.15	−6	+1.25	+195
8	—	+135	+225	—	+225
9	—	+190	0	—	6.3 vac

output signal is as free of distortion as the HT-32 that drives it. Incidentally, quality will be degraded if you feed over ½ watt into the mixer. You'll need to retune the circuits if you travel over 400 kc.

Power supply

I am using an electronically regulated supply for B+. This is recommended as it assures a constant voltage on the oscillator for stability and constant voltage on the stages in linear operation.

Adjustment

You'll need a 20,000 ohms per volt multimeter and relative power meter or swr bridge for initial tune up. A grid dip meter is a great help in pruning coils and setting tuned circuits to frequency.

With B+ only on the oscillator (check this voltage) and the slug as deep into the oscillator coil L1 as it will go, slowly screw the slug out until the 6AB4 starts to oscillate, as evidenced by bias developed at pin 2 of V2. Set the slug in this position. Turn the plate voltage off and then reapply it to be sure that the oscillator takes off again. If it does not start up again try a different setting of the slug. In general, the optimum setting is at a frequency slightly higher than the setting which produces maximum output. Turn the power off and connect power to the tripler and the injection amplifier. Reading bias voltage developed across the grid resistor of the 6BU8, tune C2 and C3 for maximum voltage. In order to get a reading to tune C2, the meter may have to read the voltage on pin 7 of V3. At this point check the voltages at all pins on VI and V2 against the voltage chart.

Again turn the power off and connect the B+ to all other stages and the bias to the final. Before turning the B+ on, be sure that there is −21 volts of bias on both grids of the 6360 (pins 1 & 3 of V5). Apply power and check the rest of the tube pins for voltage against the chart. If less than one volt or more than three volts appear on pins 2 & 7 of the 6AK5 (these voltages must be positive) turn off the power and determine the cause. Check for plate voltage first. If it is present, check to see if the cathode resistor or bypass capacitor is defective, if so, replace the faulty component and try again.

When bias is present on the cathode of the 6AK5, apply about 100 milliwatts of 21 mc drive to the suppressor grids of the mixer and, using the power indicator, tune C4 through C9 for maximum 144 mc output. Remove the 21 mc signal and be sure that the output goes to zero. All 144 mc tuned circuits should hit 144 at about half capacitance if they have been properly constructed. With the exception of L8A, C6 all 144 mc circuits should not tune lower than 133 mc. If output remains after 21 mc drive has been removed, get out the GDO and find out why. If good shielding practice has been observed there should be no trouble with spurious oscillation.

When all appears to be in proper order, reapply the 21 mc drive at about 100 mw. If grid voltage on the 6BU8 is near that listed in **Table 1.** the local oscillator chain may be retuned for maximum output at this time using the power meter for reference, this step may not be necessary. Slowly increase the 21 mc signal until the output peaks. Note the setting of the drive control or loading at this point and, when on the air, operate with a little less 21 mc power than this. If the 21 mc drive is at a higher level than this the unit will overmodulate, distort, and the output will drop. A good idea is to construct an attenuator to drop the full output of the generator to that level required by the heterodyne unit.[2]

My grateful thanks to Bill Ashby (K2TKN) and Paul Todd (W2UM) for assistance and encouragement on this project and in preparing this report. Thanks and praise are due John Peoples, a fellow employee, for turning out the excellent pictures for this report.

. . . WA2JAM

1. Heterodyne Exciter with 6BU8 Twin Pentode Balanced Mixer *G.E. Ham News Sideband Handbook,* First Edition, p. 11-36. 2. W9ERU, "A Step-Type RF Attenuator." *QST,* December 1959, p. 20.

Coil Table

	Turns	*Diameter*	*Wire*	*Form*	*Length*
L1	8	⅜	22 en.	iron slug	close wound
L2	3	⅜	16 tin.	air wound	⅜
L3	4	⅜	16 tin.	air wound	½
L4	14 CT	½	20 tin.	air wound	⅞
L5	2	Insulated hookup wire at center of L4.			
L6	There is no L6			Folded line. See photo.	½
L7	4½	½	16 tin.		
L8	1	Insulated link at center of L7.			
L8A	3	⅜	16 tin.	air wound	⅜
L9	4	⅜	16 tin.	air wound	½
L10	1	Insulated link at cold end of L9.			
L11	Same as L8.				
L12	5	⅜	16 tin.		Same as L7.
L13	7	Same as L12.			
L14	Same as L11.				

Ronald Vaceluke W9SEK
Buckhorn Ranch Trailer Park
Lot B-39
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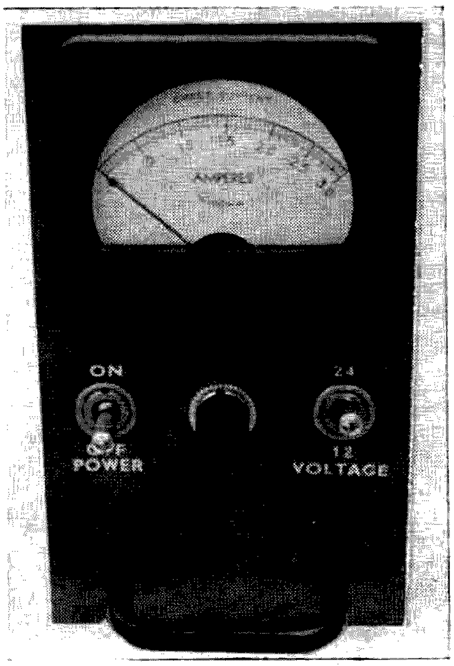
A Regulated Solid-State Supply

In the old days when vacuum tubes were in vogue, it was an easy matter to obtain operating voltages for experiments and testing equipment. This was done by tapping off power supplies in whatever gear was at hand. Then came a wonderful little device known as the transistor (sometimes known as a "three legged fuse"). Most everyone was happy with these semiconducting devices (except for tube manufacturers), especially battery manufacturers. This was a shot in the arm for new and better batteries. Battery power was fine for the old breed of transistors that only consumed milliamperes, but the new breed has some mighty hungry units that consume AMPS. The old dry cell doesn't last long with this kind of power drawn from it. And the wet cell—the less said about this messy device the better.

A short while back I started a project on a solid state UHF exciter. My first thoughts were on how best to power the unit. Since the total power consumption of the unit was to be about one-and-a-half amps, batteries were out of the question. A transformer and bridge rectifier was OK, except with a small load (the oscillator and buffer in my case) the voltage was high. As the load increased, the voltage of course came down. Since the junction capacitance of a transistor will change somewhat with varying voltage, this makes it difficult to keep a stage tuned properly at the higher frequencies. The only solution to the problem is to stabilize the voltage.



The regulated solid-state power supply.

There are many ways to make a stable voltage source, some of which get rather involved and expensive. Since my needs were not too critical, I chose the simplest method which is the series regulator, which will hold within 2 volts from no load to full load. In my case I needed 24 volts for the exciter under normal operating conditions; however, it was deemed desirable to be able to reduce this voltage for initial testing and experimentation. What finally evolved was a 12/24 volt supply capable of delivering 3 amps at 24 volts and 1½ amps at 12 volts. The current limitation at 12 volts is set by the dissipation of the transistor and heat sink. Power dissipation of the transistor is approximately equal to supply voltage in minus

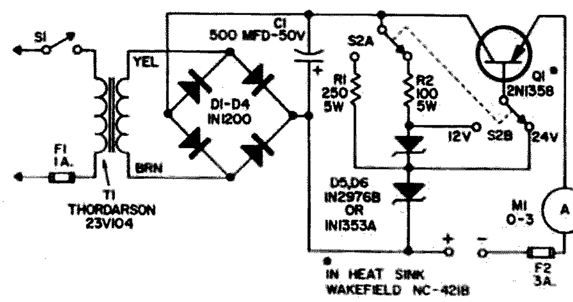
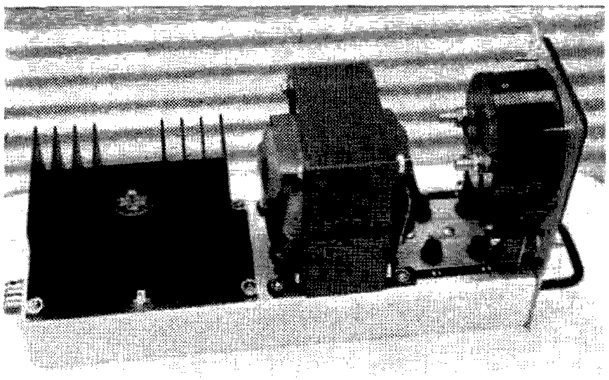


Fig. 1. Schematic of the supply.



Side view of the regulated power supply.

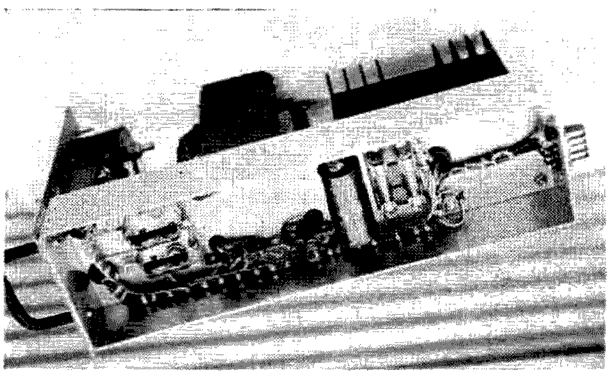
voltage out multiplied by the load current. Since the supply voltage is approximately 35 volts, it can be seen that 34.5 watts is dissipated with a load of 1.5 amps with the output set at 12 volts. This is close to the maximum safe limit for the heat sink I used and keeping within the temperature rating of the regulator transistor.

The supply was built on a home made chassis 11" x 3¼" x 1½" with a small front panel 3½" x 6⅛" in size. The rear apron has an Amphenol Blue Ribbon Connector so that the supply can be inserted or removed from the main cabinet with ease and all connections made simultaneously. This also facilitates replacing the fuses should the need arise. Two banana jacks on the front panel may be more convenient to some and can be installed. Do whatever is best for you.

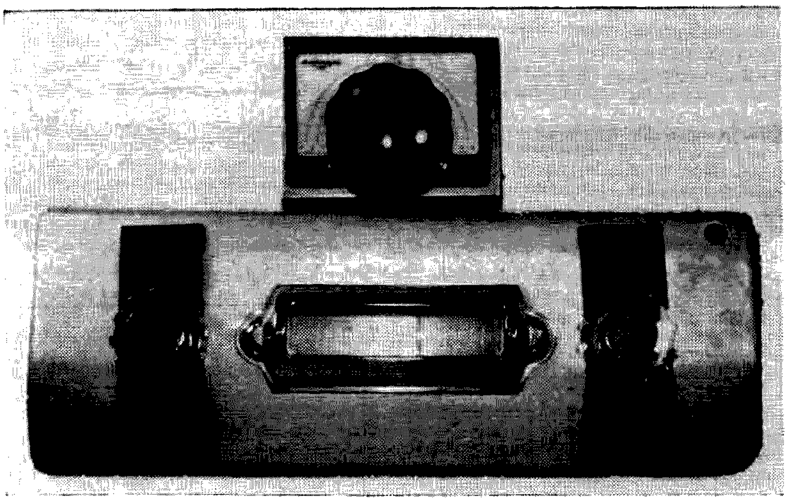
Since my rig will use 24 volts under normal circumstances, I will still be dissipating 33 watts while drawing 3 amps. Construction is not critical and general layout can be seen from the photos. The only precaution is to use heavy gauge wire in the unit to prevent IR losses.

For those who wish to use different transistors and/or voltages, I refer them to Motorola Application Bulletin No. AN-103 from which I received my data.

. . . W9SEK



Bottom view of the supply.



Transistor Twenty

Robert Scott
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Here is one project which won't be stuck on a shelf when you finish it. It's a tunable 20 meter transistorized converter for use with a standard broadcast receiver. I'm using it with a converted auto radio and it does a fine job of dragging in those DX stations.

At first glance, it can be seen that there are two broad band RF stages followed by the mixer. In a separate compartment is the oscillator which is tuned by the main tuning dial. The whole thing is powered by a self contained 9 volt transistor battery. Current drain is about 3 ma.

The nice thing is that no major operation on your car radio is necessary to use this converter. Just plug in the antenna and output cables and turn the switches and you're in business.

Good design practice would be to tap down on the coils for proper impedance matching, but these miniature coils are hard to tap, so I used them without taps. It works fine and the loading helps flatten the passband. Glass coupling and tuning capacitors were used because of their small size, but either ceramic or mica would work fine.

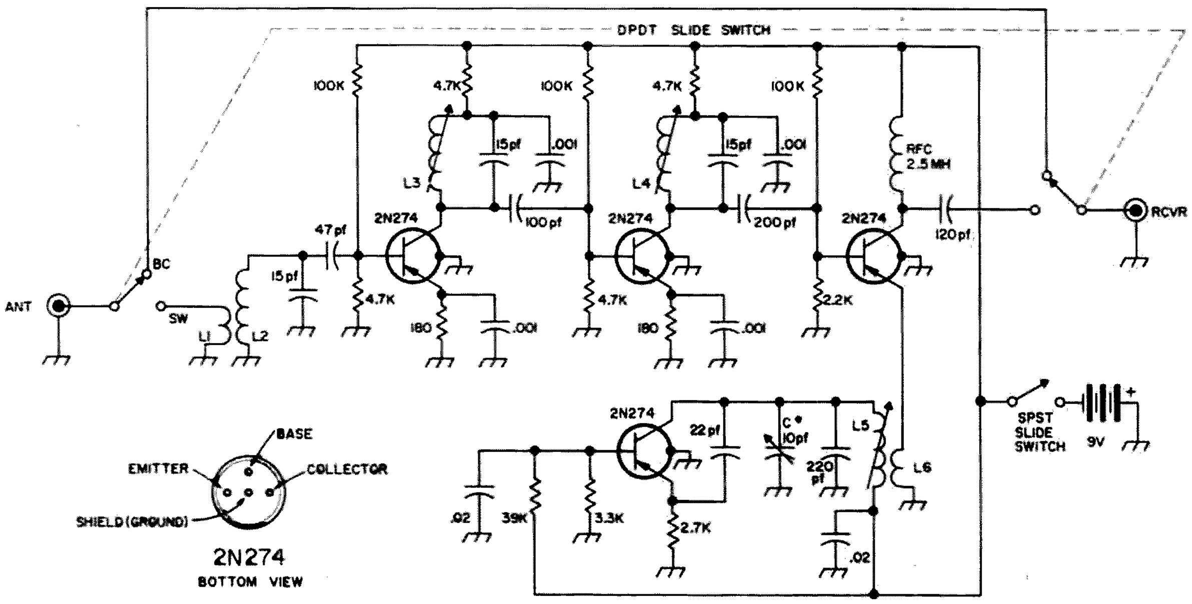
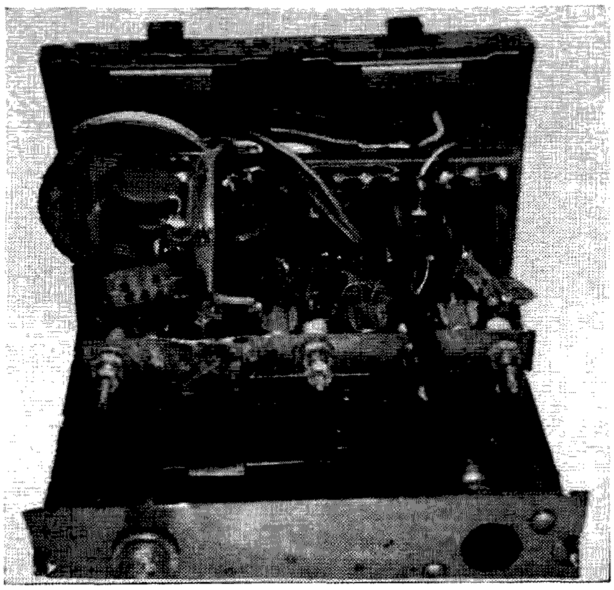


Fig. 1. The transistorized tunable twenty meter converter.



Interior view of the converter.

The transistors are mounted in fuse clips which are riveted or soldered to the chassis so they won't bounce around—and off. Small terminal boards were used to mount most of the components. Layout was made with the ideal of using a National MCN dial and the panel had to be large enough to mount it. You could make the converter much smaller, however. The variable was a surplus one, but any small 10 pf one should do.

Alignment is not difficult, but a grid dip meter, signal generator and VTVM are necessary. First dip all coils to the proper frequencies with power on, then see that the oscillator is operating and tune it to frequency using the GDO as a detector. Connect the converter to the receiver to be used and feed a small signal to the antenna input. Use 14.25 mc and tune the receiver to somewhere between 1400 and 1600 kc where there is no signal. Now tune the oscillator coil until some signal is noticed and peak the antenna and RF coils for maximum AVC voltage on the receiver.

As for performance of the converter, I tested it with a HQ-160 receiver. A signal was fed into the input from a Hewlett Packard 608D signal generator. It took a 2 μv signal for S9. S6 was 0.2 μv. All in all, this seems to be a hot little converter and is ready and willing to go to work almost any place. You could put it on other bands for a little fun. For higher frequencies, you should use a more modern transistor.

. . . Scott

Coils

L1 . . . 3 turns #32 on cold end of L2.
L2, L3, L4 . . . Miller 4306.
L5 . . . Miller 4303.
L6 . . . 3 turns #32 in center of L5.

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Framing your Awards

Most of the ham stations which I have visited over many years, both those of the 'old timer' as well as the embryo ham, are proud to display the awards they have won in ham radio and which are generally in the form of a 'certificate' resembling a bond but, unfortunately, un-negotiable, of course . . . hi! It has always seemed somewhat of a shame to me to see such awards thumb-tacked or taped to the shack wall. Most of these have been earned by hard work and buckets of sweat; why desecrate them through slip-shod mounting and display?

Certainly, it will cost a bit more than 'peanuts' if you have each one commercially framed but you don't have to do it that way. your local novelty or dime store no doubt has many framed photos of movie stars, landscapes etc., for sale at very nominal prices. I've purchased many for from 35c to 75c each. This includes not only a machine cut, perfectly mitered frame but the glass and backing as well. Mostly available are the narrow, dull black finished frames; these are ideal for certificate mounting; they make a dignified appearance on the shack walls. It's the *certificate* you want to display, *not* the frame!

All you need do is to remove "Marilyn Monroe" or a scenic view of a mountain range, ocean or desert, insert your award certificate and you've got it made. You may have to trim your certificate a bit on the edges but in every case I've seen, ample room is available for such 'cropping.' Most award certificates are on either 8" x 10" or 8½" x 11" paper stock; the majority of frames which I have encountered in the variety stores, accommodate this size nicely. If the certificate is smaller than the frame area, secure it first to a 'mat-board' backing before mounting in the frame. Mat-board is generally available at variety stores also and is simply a heavy cardboard, available in a variety of colors although a buff seems to be most in demand. Generally such mat-board has a 'pebbled' surface on one side; this makes a pleasing contrast between the certificate and the edge of the frame.

Mounting the completed frame assembly on your shack wall is no problem. If your shack occupies a bedroom or a similar area in the home, you can hang it in the conventional manner using picture wire and a small brad, phonograph needle or 'push-pin.'! Any of these will leave only a tiny hole in the wall surface, easily patched if you have to move, with a spot of chewing gum or window glazers putty; neither will ever be noticed.

One objection to the above type of mounting is that the frame will no doubt, occasionally become askew and need a bit of levelling by eye. If you can get away with *two* tiny holes in the wall, a more satisfactory method as used by the writer will eliminate this occasional annoyance. Tiny screw-eyes which are available at practically all hardware, variety and novelty stores, can usually be had for about 10c a card; cards ordinarily contain ten or twelve of these miniature screw-eyes; enough to mount five or six frames.

Screw one of these little eyes in the center of each of the vertical members of the frame. Be careful here to make a 'pilot hole' with a small brad or similar so that the screw eye won't split the frame member. Using tiny (#4 or #2) round head blued steel wood screws about ½" long, passed through the holes in the screw eyes, will permit mounting to any solid surface, such as a wood wall. If it is a plastered wall, you may need longer screws; you'll have to determine that to suit your condition.

This is but *one* suggestion for making your station neat and presentable to visitors at all times; take a good look at many items of station accessories; you'll find many ways in which they can be cleaned up with little effort. Any efforts you make in this connection can only reflect in respectful admiration from your station visitors, be they ham or layman; it's worth thinking about isn't it?

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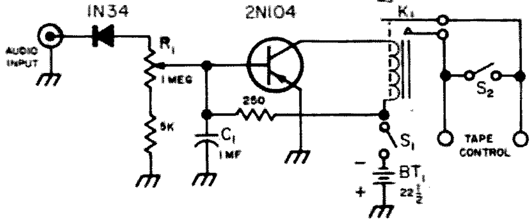
The Lazy Man's Phone CQ'er

It is obvious to the vast majority of radio amateurs that the installation and use of nothing more than a standard tape recorder for the purposes of calling CQ over the amateur bands is simple and effective, not a novelty. However, uniqueness in such a system can only be achieved when provision for automatic message-shutoff is added to a standard tape recording system for the ham shack.

Before advancing to the description of such an automatic feature for amateur radio, a brief analysis of the present scene concerning amateur equipment for pre-recorded CQs is in order. A device for pre-recording CQs for code (A1 or A2) purposes and for its eventual playback over the amateur radio station is shown in Skutt's article in QST.[1] It consisted of a modified record player which revolved a punched disc; in turn, this punched disc actuated a photo-electric cell for the production of the dits and the dahs for calling a CQ by way of a code transmitter. The novel feature of this device was the ability for turning the record player off by cutting the current to its motor without disturbing the flow of current to the other electrical circuits associated with it. On the other hand, if one were to use any tape recorder, the turning off of the message without the turning off of its electrical amplifiers (and preamplifiers) could only be accomplished manually on the tape deck itself. A system for automatic shutoff of the message (at the end of the message) is required without shutting off the power to the same tape recorder and without the annoyance of operating the stop control on the tape deck. The reason is self-evident in that the radio amateur desires full freedom of action at the end of a CQ for his tuning in on his amateur receiver for possible calls in response to his CQ.



1. Robert R. Skutt, "Lazy Man's CQ'er," *QST*, October 1961.

Fig. 1 illustrates such an automatic device. The audio output of the tape recorder's playback preamplifier is fed into the audio input of the amateur's transmitter and into the jack denoted as Audio Input in Fig. 1. The diode, a 1N34, rectifies this audio signal and feeds it into the 1 megohm potentiometer, R1, and C1 network. This network achieves a maximum time constant of one second. This is an ample delay period to prevent accidental tripping of the circuit's relay, K1, during pauses between each word in the pre-recorded message. R1 should be adjusted to meet the specific voice characteristics of the radio operator involved. In turn, this aforesaid network inserts a pulsating direct current across the base resistor, a five-thousand ohm resistor. This presents a rather high input impedance to match the output impedance of most tape recorders' playback preamplifiers for maximum energy transfer. A 2N104 relay amplifier actuates the circuit's relay, K1. Any energy losses incurred in the R1 and C1 network are compensated for by the added sensitivity given to this 2N104 relay amplifier. The terminals designated as tape control are connected in series with the current line supplying energy to the play-stop relay in the tape deck. This will be elaborated upon further. S2 must be closed in order to start playing the pre-recorded message (of course, in conjunction with the play switch on the tape deck). Once the message has been started, S2 must be opened in order for the

device in Fig. 1 to operate in accord with its automatic features, because at the end of the message the relay, K1, will open and the tape will automatically be stopped while the motors and electronic circuitry of the tape recorder are still operating.

The electronic and mechanical assembly of Fig. 1 was built upon a 5in. by 4in. by 4in. "minibox." Since a standard minibox was not available to this author at the time, the above mentioned box was constructed using standard sheet-metal techniques. R1, S2, the Audio Input jack, and the Tape Control jacks were mounted on its front face. S1 and BT1 were mounted directly in the back of this box. All circuitry was kept as close to the components in the front as possible, using standard solder strips for this purpose.

It was mentioned before that the connections from the Tape Control terminals would be discussed further for more clarity in this regard. This author uses a Concertone type 61 recorder in which two separate supply and takeup motors are used in addition to a separate drive, capstan motor leaving a total of three motors. All of its functions are operated by several pushbuttons (five, to be exact) in conjunction with relays and solenoids. Furthermore, the mechanical stopping-arm which electrically stops the play operating position without affecting the capstan motor and electronics at the end of one reel of tape, actuates just one micro-switch, which is connected to the tape deck electronics via two wires. (This switch, in other words, is a spst switch.) Therefore, in order to stop the reeling-in of tape in the play position without turning off the motors or electrical circuits, one must just break one connection of one of these two aforementioned wires. And that's where the connections from the Tape Control terminal are made in series with this above mentioned micro-switch.

The benefits from such a system are numerous. To explain several would be in order. Having mentioned its use as an automatic CQ-er, one may note that it may also be used as a source of automatic test signals for realizing the full capabilities of an amateur radio transmitter. Turn on your transmitter and turn on your voice via this system! You are now set up for BCI and TVI testing in your home. Of course, at the end of such a test period (preferably ten minutes), this unit may be connected so as to turn off not only the reeling of the tape on the tape deck, but also the amateur transmitter. How automatic will amateur radio become?

. . . WA2MTB

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The 1215 Transistor Superhet

Part I: the Mixer

UHF experimenting is fun. Talking to someone on 432 or 1250 takes some work, but gives you the thrill of knowing that you have accomplished something that few other hams have done. In the May 1965 73, I described a tube-type station for 1215 mc. Since it was developed, I have done some more work and come up with a this simple-to-build transistorized receiver for the band. It is for broadband reception, but can be modified for narrowband use if desired. You can have a lot of fun with this receiver. You can receive APX-6's, the narrow band boys on 1296 mc, modulated oscillators such as the one I described before, or (low power?) transistor transmitters.

Perhaps something should be said for modulated oscillators on UHF. They're a convenient way to get on the bands. No one claims that you are going to work real DX with this simple equipment, but moderate distances can be covered easily and you can have plenty of fun experimenting with antennas, mixers, etc. The stabilized boys look down their long string of multipliers at modulated oscillators, but there's plenty of room (85 mc) for many newcomers, whether they use 10 mc wide TV signals or CW, modulated oscillators or SSB.

This article, the first of three, describes the mixer for the 1215-1300 mc receiver. Future articles describe the local oscillator and *if*-audio strip. The mixer and oscillator are built in modular form (i.e., Miniboxes). You can unplug the tunable local oscillator and substitute a crystal-controlled one and you can replace the broadbands *if* with a communications receiver. And you can use the same *if* with other oscillators and mixers for the 430 mc or other bands.

Details of the mixer

The mixer in this receiver is considerably easier to build than the cavity mixer I used in

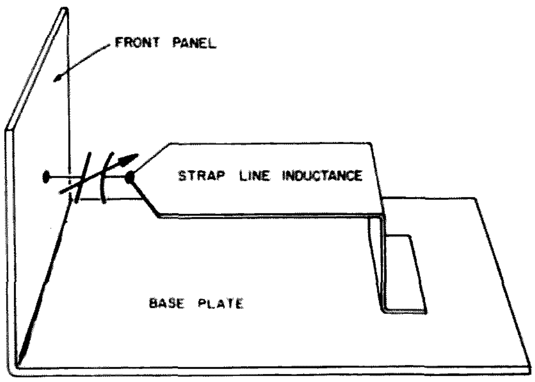

Fig. 1. Simple strap line tuned circuit. Good on 432 and even up to 1200 mc.

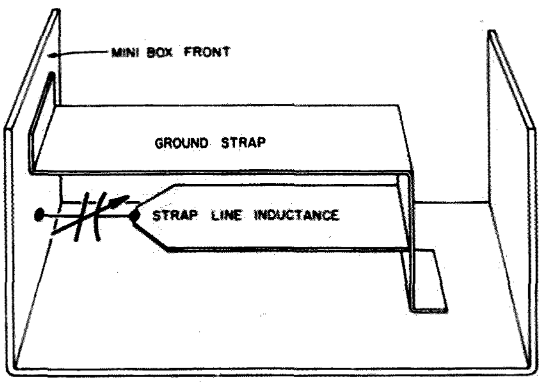

Fig. 2. Strap line with ground plane over it. Note similarity to trough line.

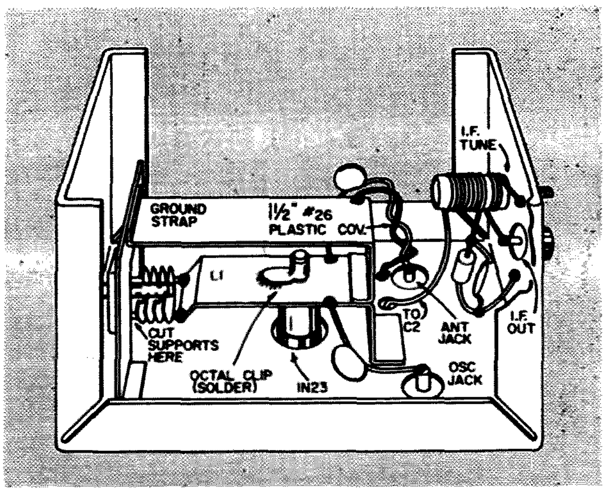

Fig. 3. Overall view of the 1200 to 1300 mc mixer.

the tube rig. But it took a long time and a lot of work to perfect. Now that I know how, though, I've made a bunch of them and they all work fine.

There are two tricks that make this mixer possible: First, cutting the stator plate supports off the ceramic base of the capacitor after the tuning strap is soldered in place. Second, making a skeleton cavity with flat ground plates on each side of the main portion of the flat strip tuned circuit.

A further benefit from the second item is that once you have enclosed the tuned circuit in the ground planes or returns, you can insert the assembly in a Minibox without change in frequency.

So let's get down to details. **Fig. 1** shows a single strapline tuned circuit. This configuration works pretty good on 432 and can even be tuned to 1200 mc. But just try to box it in! I worked for weeks on that one. The solution is to put a second ground plane above the strap as shown in **Fig. 2.** Now it can be put in a box or even built right on one side of a Minibox. The sides make a convenient place for connections since they are grounded for RF and DC.

Construction and components

Now for the details on the 1200 to 1300 mc mixer. **Fig. 3** is an overall view. As for the capacitor, use the smallest variable you can find (Hammarlund MAC-5). Cut the supports very carefully after you've soldered the tuning line in place. I used dentist's scissors.

LI is shown in **Fig. 4.** It is fastened to the Minibox base with 4/40 bolts and nuts and then soldered to CI. Then cut off the stator supports after soldering. The stator plates will remain in the proper position.

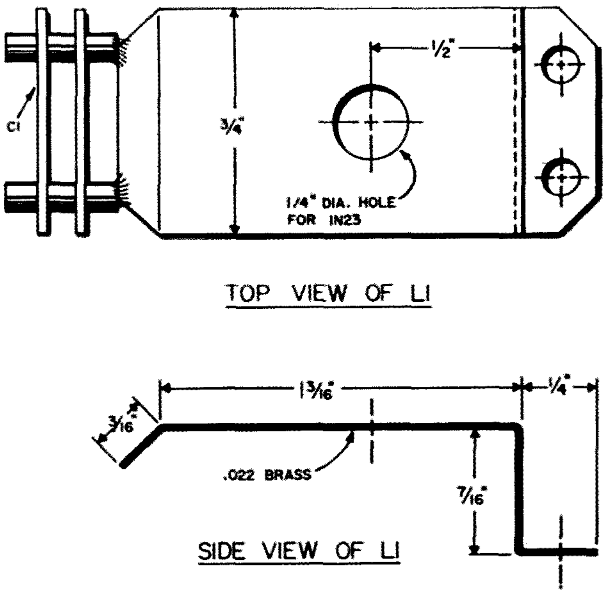

Fig. 4. Details of LI. See Fig. 3 for location.

The crystal used is a 1N23. Crystals such as the 1N23B or C are more expensive and can offer a lower noise figure. Use whatever suits you—even a surplus one may be fine. Don't forget that the noise figure is determined by the *if* as well as the crystal. UHF TV sets have used the 1N82A, but it's not as good as the 1N23.

In the mixer shown, the small tip of the crystal goes clear through LI and slides into

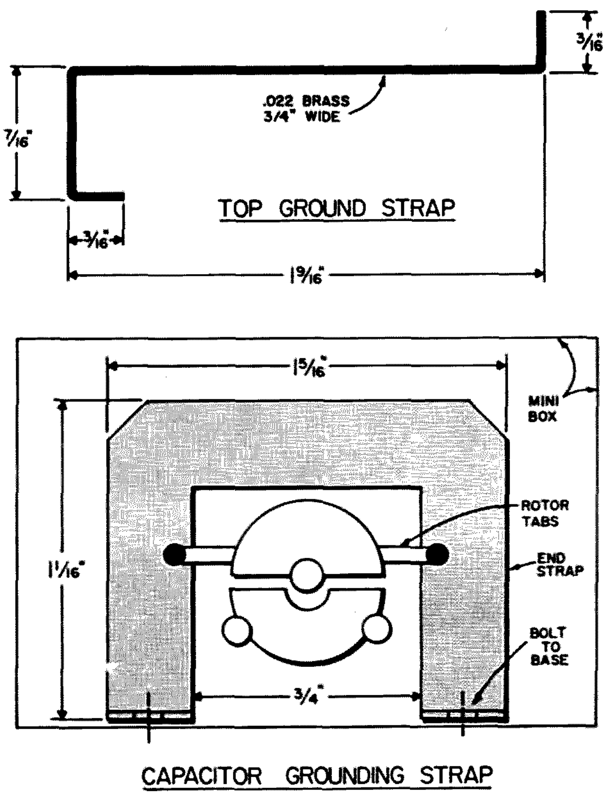

Fig. 5. Details of the top ground strap and the capacitor grounding strap.

a clip taken from an old octal socket. This clip is soldered to the top of L1—preferably with a defunct 1N23 to hold the clip in place while soldering.

The top ground strap is shown in **Fig. 5** and is not very complicated. Solder on top of L1 and to the C1 grounding strap also shown in **Fig. 5**. Solder the two rotor lugs of C1 to this piece after bolting down to the Minibox base.

The crystal bypass capacitor is shown in **Fig. 6** along with the oscillator and antenna jacks. A ¼ inch hole is drilled in the brass plate for the cartridge and the Minibox is drilled out to nearly ½ inch. The crystal should not be allowed to short to the Minibox. And don't forget insulating tape under the brass plate. An insulated lead goes right down through the box to the inside and over the 28 mc tuned *if* coil, L2. This coil can be a store-bought slug tuned 10 m coil or you can make your own. The 1000 ohm resistor in series with the crystal return is needed to furnish some bias for the mixing operation. You might try different values of bias for optimum results.

I used phono jacks with ceramic insulation for RF connections. I trimmed them down with a razor saw and used 1/72 bolts (2/56

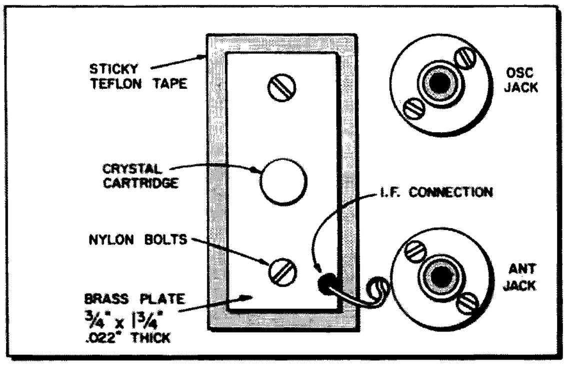

Fig. 6. Crystal bypass capacitor and back view of the Minibox.

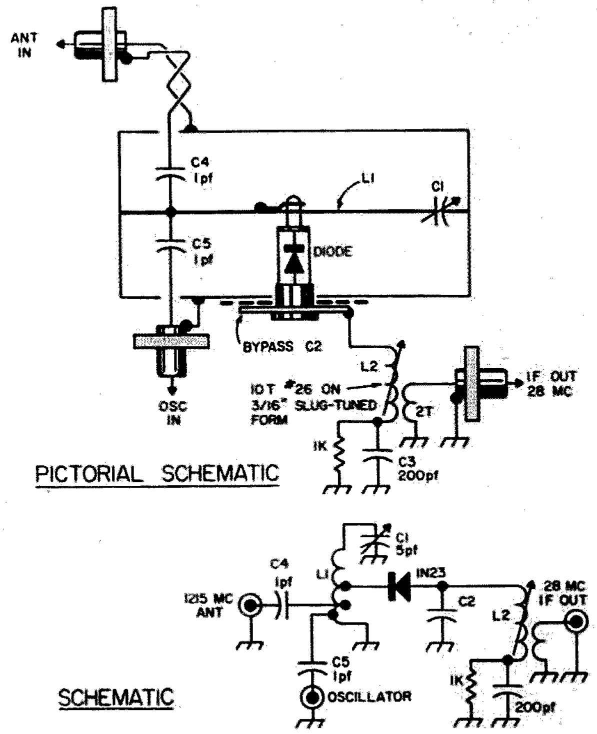

Fig. 7. Pictorial schematic and schematic of the 1250 mc mixer.

will do. I just wanted to show off that I had 1/72 bolts.) You can get them and the razor saw in a hobby shop. The jacks are located on either side of L1, as shown in **Fig. 4**. The oscillator jack has a one pf small disc capacitor with about ⅛ inch leads connected to it. The other lead goes to L1 about ⅛ each from the cold end.

Some pulling of the oscillator can be found as C1 is tuned, but not too much. Of course, you can use a 200 mc *if* to reduce this, but that brings up other problems. The 28 mc *if* and local oscillator will be covered in future articles.

. . . K1CLL

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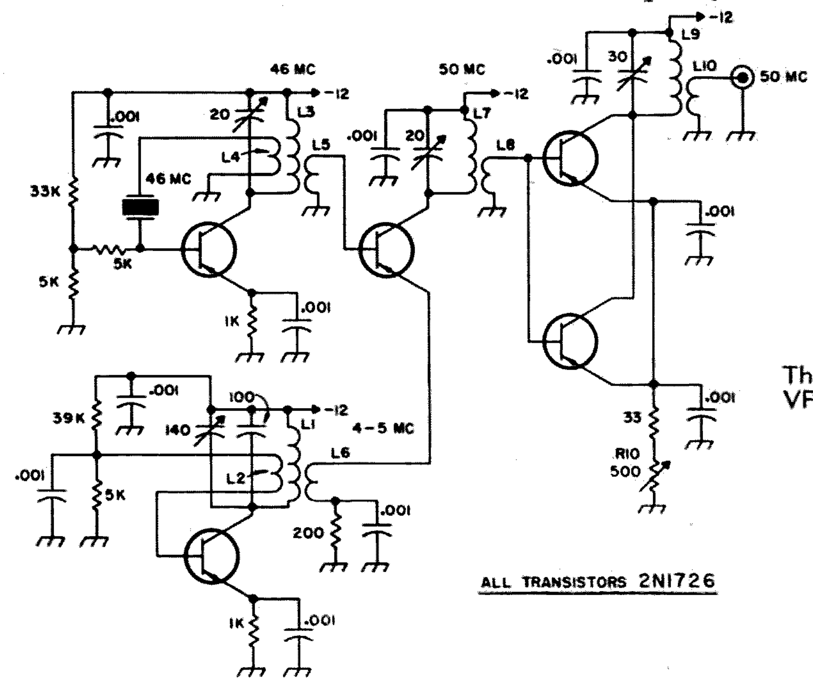
The Solid State Slippery Six

A really low cost practical heterodyne VFO rig for six meters is described. The Sprague 2N1726 transistors used are listed amateur net, quantities 1 to 99, for only $1.15. And as you will see they are actually easier to handle and tune up than tubes, once you get used to them. No line cord, no transformer power supply, just a small 9 or 12 volt battery and away you go, shack, car, or on foot.

First a brief word on the heterodyne VFO principle for new readers (and others) that may have missed the Compactron heterodyne-VFO in 73 before. Six meters has been for some time, to a major extent, a VFO band. You get rock-bound and you are really tied up. Friends, new stations, chatting gaily a little away on the dial, and you can't reach 'em. And with the highly portable feature (house, car, or on foot) of this transistor transmitter you can develop an advanced case of frustration when you arrive on a nice hill an hour or so from home, plenty of interesting new calls batting in on the receiver, if you do not use the VFO feature.

So you need a VFO. My advice: don't build a low frequency one that has to be ultra-stable because it multiplies up in frequency. Start with a 45 or 46 megacycle



The six meter solid state heterodyne VFO exciter.

crystal oscillator, *add* on a simple 4 to 5 mc oscillator in a mixer, and there you are, on 50 mc, stable but not rock-bound. No hum, no drift, no FM'ing, easy zeroing in, and highly portable. How can you lose?

The Sprague 2N1726 transistors are made in New Hampshire on some pretty fancy automatic machinery which is probably paid for by now, as they list for only $1.15 amateur net. Of course you can go hog wild with your dough and use 2N1745's for $1.80 each, that's up to you. A little more gain, but I use the 2N1726s myself.

Fig. 1 is the schematic. Both oscillators are strong oscillators having been maximized for gain and efficiency and will work at very low voltages which is always a good test for oscillators. The 4 to 5 mc one uses a collector winding L1 made of No. 26 DSC, two pi, each 25 turns, using a mixture that I call "progressive jumble" wound, for a total of ⅝ inch. L2 is wound between and over the two sections. The coil form is impregnated paper with internal thread and a 6/32 threaded core for adjustment. You can use another form if it tunes 4 to 5 megacycles with a total capacitance close to that shown in Fig. 1.

L2 is 6 turns No. 30 DCC and is wound in the same direction as L1 and the base then goes to the opposite end from the collector. For the fixed capacitor across L1 use a dipped silver mica. The crystal oscillator is just as straightforward and neat. L3 is 9 turns of ⅝ diameter air wound, 8 turns per inch, and is tuned to 46 megacycles. L4 is two turns small plastic covered wire wound on top of L3 near the middle. If L4 is wound in the same direction as L3 connect the base to the opposite end from the collector, and you can't miss.

In both these oscillators the 1K resistor in the emitter will protect the transistors whether they are oscillating or not. A milliammeter in the mixer collector return lead to the minus 12v during tune-up will serve as an RF indicator for the oscillators if you don't have a handy-dandy RF detector.

The mixer does not need external DC bias as it is driven by the RF from the oscillators which develops the correct amount of bias on the 200 ohm emitter resistor. Transistors are natural born mixers. This one gave out with lots of 50 mc immediately on being fired up.

L7 tunes 50 to 51 megacycles and is 10 turns of ⅝ diameter air wound, 8 turns per inch. L8 is semi-adjustable. I used about 1½ turns on the cold end of L7. Not critical, but it pays to trim up for power and tune-up for frequency.

The RF amplifier does not use any external DC bias either as it develops what it needs in the emitter resistor due to the rectifier action in the base-emitter diode circuit.

The variable 500 ohm resistor can be replaced by a fixed one but there is a consideration here. The 2N1726's are low cost low power units and when you light a No. 48 or 49 bulb bright you are pushing them. So the 500 ohm variable is known as a "drive control" and works quite well at it. I would suggest somewhere around 10 or 12 mils collector current for the two RF finals in parallel. More on that later.

L9 is 10 turns airwound, 8/per inch, not critical. A No. 48 bulb across 2 or 3 turns from the cold end of L9 will light up dull red with R10 set at 100 ohms and over, and fairly bright with R10 at zero ohms. Once again, watch those collector mils!

If you want to push things even a little more you can add two 1.5 volt cells to the minus 12 volts, 15 volts total, and get out like mad. You should have some spare 2N1726's on hand though!

So, that's it for now, see you on six from one of those beautiful big QRM free walk-up mountain tops!

. . . K1CLL

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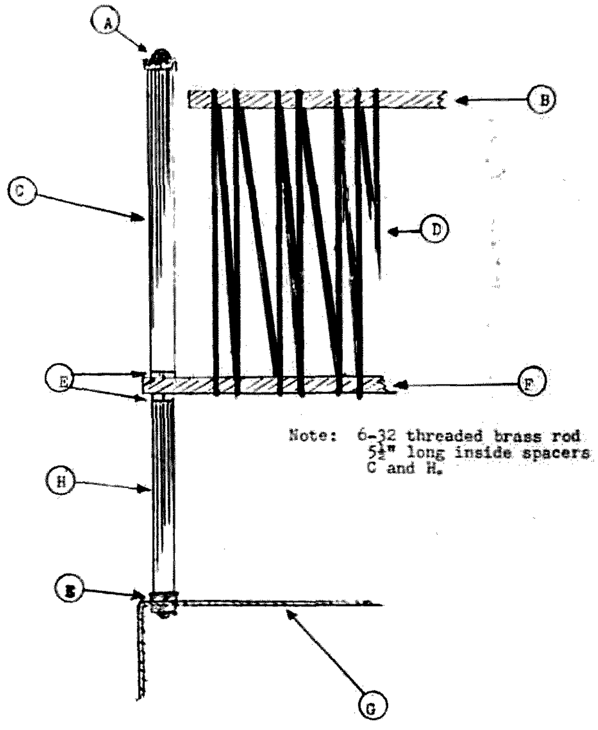
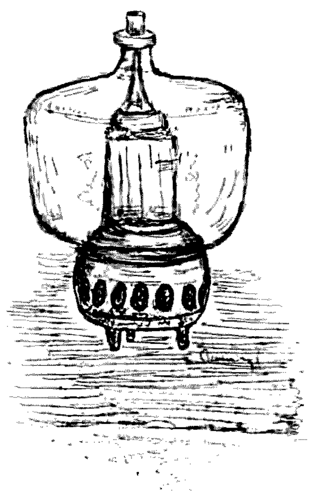
A Tip for Transmitter Owners

Regardless of whether your amateur transmitter is a factory wired job, one built from a kit or completely "home-brewed", chances are good that the final amplifier tank coil is exposed on the top of the chassis. You occasionally find it necessary to make repairs or a check of components on the underside of the chassis. To do so means turning the chassis over and laying it on your work-bench. In many cases, this puts the weight of the entire chassis with its heavy transformers and other components on the final amplifier tank coil for support. These coils are not designed to serve as supports. More frequently than not, using them as such results in breaking the spacer bar on top of the coil.

I had this experience with my first Viking Ranger. The steatite spacer bar on top of the coil took the entire chassis load when the chassis was turned over to perform minor service operations. It immediately broke at one of the grooves in which the wire was wound. I've had several Rangers as well as other transmitters since then, and in every case, before I reversed the chassis for any reason, I fitted it with a support rod to carry the weight. Such support can remain in place as a permanent part of the chassis. It does no harm either electrically or mechanically and will often save you the necessity of replacing or repairing the coil spacer bar; a rather ticklish job at best. The accompanying sketch shows how I handled the situation on the Viking Rangers. This same idea is of course, adaptable to transmitters of any make or configuration of components if they present a similar problem. Minor modifications of this scheme will probably be necessary for transmitters other than the Ranger but the object is the same: provide support for the chassis other than by the tank coil!



Mounting Details for Support Stud
A—6-32 Acorn nut
B—Upper steatite spacer bar
C—Metal spacer (optional)
D—Final tank coil winding
E—6-32 Hexagonal nuts
F—Lower steatite spacer bar
G—Chassis
H—Factory supplied spacer.



Dimensions shown on the sketch apply to the Ranger II and will naturally vary with other transmitter types.

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Field Effect Transistor Primer

How would you like to use a transistor that behaves like a pentode vacuum tube? The field effect transistor (FET) is just such a device. With this transistor it is possible to take just about any tube-type circuit and transistorize it by changing one resistor and the power supply voltage! You don't even have to change the power supply if you add a dropping resistor. The FET has many desirable features that should be popular including high input impedance, low noise and voltage controlled operation. This device also features very high power gain, evceeding that of conventional transistors in the audio range. Field effect transistors have been available commercially since 1960, but until recently the cost of individual units has been too high to be considered for amateur applications. However, there are now field effect transistors on the market for as low as one dollar apiece.

The concept of the field effect transistor actually pre-dates the junction transistor. Just after World War II, scientists at Bell Telephone Laboratories were trying to develop a semiconductor version of the vacuum tube. However, the prototype device failed to give the predicted results because of problems with the semiconductor surface. It was the research into these surface problems that led to the discovery of the point contact transistor and the ultimate development of the junction

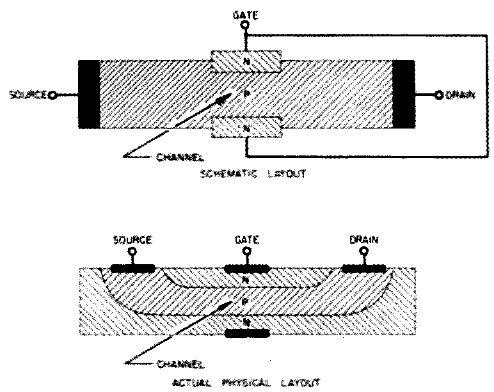


Fig. 1. The Field effect transistor.

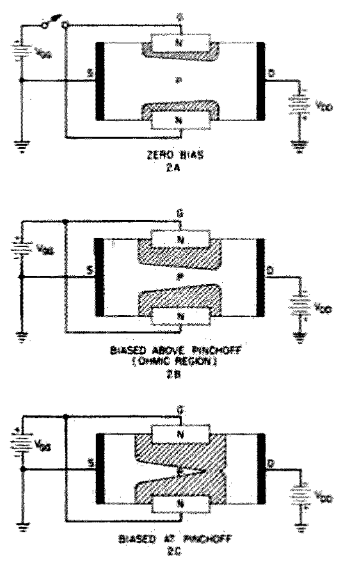


Fig. 2. FET depletion regions.

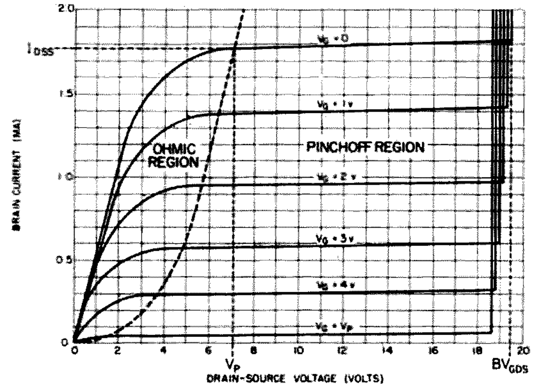


Fig. 3. FET drain characteristics.

transistor. Had industry first concentrated on perfecting the FET rather than the conventional junction transistor, it would be reasonable to say that most circuits would be using FET's and conventional transistors would be used only for special applications, a complete reversal of the situation today.

The basic elements of the field effect transistor are the source, drain and gate, corresponding respectively to the cathode, plate and grid of the vacuum tube. It might seem logical to use vacuum tube terminology for FET's and at least one pioneer manufacturer is doing this, but recent companies have failed to follow suit and it appears that the newer terminology is more widely used.

Basically, the field effect transistor consists of a bar of semiconductor material with two contacts, the source and the drain, at either end as illustrated schematically in **Fig. 1.** Two semiconductor junctions built into the middle of the bar are connected in parallel to serve as the gate; the space between the gates is called the channel. Field effect transistors are classified as N- or P-channel devices, depending upon the electrical properties of the semiconductor material used in the channel.

The operation of the FET is really quite simple and straight forward. In normal use it is biased as shown in **Fig. 2** with the source grounded and the gate in the zero or reversed biased condition, (i.e., for the P-channel device, the gate voltage is zero or positive and the drain negative). When the gate is reverse biased, a depletion region forms around each of the gate elements. The term depletion means simply that the region is void of current carriers (electrons or holes). In the P-channel FET, the gates are constructed from N-type material and a positive bias voltage is applied.

When the gate junctions are formed during the manufacturing process, electrons from the N material cross the junction and recombine with holes on the P side. This exchange of electrons creates an electrostatic field across the junction with the positive charges residing on the N side and the negative charges on the P side of the junction. This field is known as the barrier potential. When an external bias is polarized such that the N-type material is more positive than the P-type, the holes and electrons move further away from the junctions, thereby increasing the width of the depletion region.

Going back to basic electricity for a moment, you will remember that the electrical resistance of any material is directly proportional to its area. This should be intuitively evident if we consider that smaller areas have a smaller number of current carrying electrons and hence higher resistivity. The basic operating mechanism of the FET is based upon the fact that resistance is a function of area.

Consider the schematic illustration in **Fig. 2**; in **2A**, where the gate bias voltage is zero, the depletion region lies very close to the gate elements and the channel is fully opened. However, as the gate bias is increased, the depletion region extends further and further into the channel (**2B**), restricting current flow by effectively increasing the resistivity. As the gate bias is further increased, the depletion regions come together as shown in **Fig. 2C** and the channel is "pinched off." The level of bias required for this to happen is referred to as the pinchoff voltage (V_P).

In a nutshell then, the operation of the field effect transistor consists of modulating the flow of current in a semiconductor channel by establishing depletion regions at each side. As these regions increase, they diminish the effective cross-section area of the channel, thereby increasing its resistance. The characteristic wedge shape of the depletion region is due to the fact that the reverse bias on the P-N junction is greatest at the drain end of the transistor.

From this discussion, it would seem that the

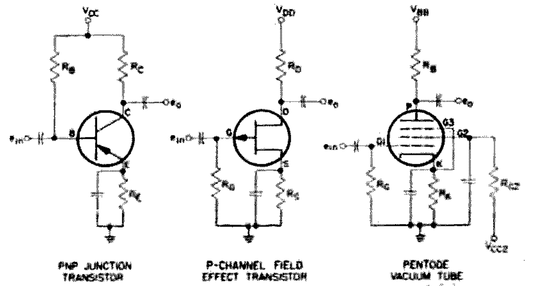


Fig. 4. Comparison of junction transistor, FET and pentode tube.

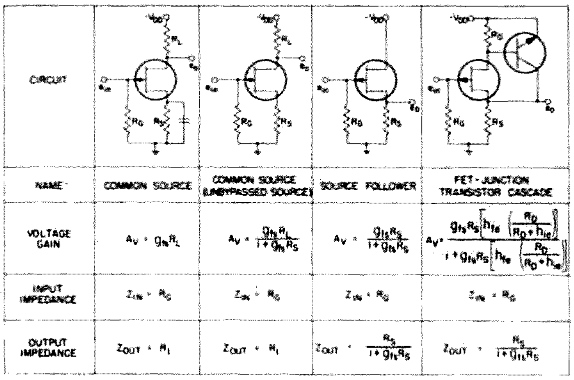


Fig. 5. Basic FET amplifier circuits.

external bias required to bring the two depletion regions together would be capable of reducing the drain current to the characteristic reverse current of the P-N junction. However, this complete pinchoff condition never occurs; in practice, the drain current approaches some irreducible minimum greater than the diode reverse current.

If the gate bias voltage is held at zero and the drain voltage is increased, the area of the depletion region will similarly enlarge and when the drain voltage is about equal to the pinchoff voltage, the channel is effectively pinched off and exhibits extremely high resistance values. If the drain voltage is increased beyond this point, there is no significant change in the current. This property is especially useful in current limiting applications and is a current anology of the voltage limiting zener diode. As the drain voltage is further increased, the electric field increases until "breakdown" occurs. Beyond this point the current between the drain and the gate increases very rapidly and the device may be permanently damaged.

At small values of current, the channel between the drain and the source acts like a linear resistor, but as the current increases, the portion of the channel near the gate junctions becomes significantly negative with respect to the source. Note in **Fig. 3** that the relatively constant slope at low voltages becomes less linear with increasing applied voltage. The point at pinchoff corresponds approximately to the voltage at the "knee" of the curve. Above the pinchoff voltage the drain current saturates and increases very little for further increases in voltage.

The symbol used for the field effect transistor has only three terminals as shown in **Fig. 4**, but its electrical behavior is more similar to the pentode tube than the triode. It should be noted that the symbol in itself does not differentiate between the source and the drain; this must be done by adding the letters S and D. Actually many devices are symmetrical and the source and drain may be interchanged, but the parameters may not necessarily have the same values in the reverse connection unless so guaranteed by the manufacturer.

Although the operating mechanism of this device is very interesting and provides some insight to what may be expected in use, more specific information is required before actual circuit application may be made. The most informative method of doing this is to plot the effect of gate voltage on the drain current (I_D) as shown in **Fig. 3.** Here the drain characteristics of the FET comprise two regions; the pinchoff region which is called the pentode region and the non-pinchoff or saturation region which is sometimes called the triode or ohmic region.

The most important of the field effect transistor's operating parameters are listed in **Table 1** along with their approximate vacuum tube equivalents. Normally only those parameters designated by an asterisk are included on the data sheet however, and are sufficient for nearly all applications. The forward transadmittance (g_{fs}) is measured in much the same way as the transconductance of the vacuum tube; that is

$$g_{fs} = \frac{\Delta I_D}{\Delta V_G} \text{ with } V_D \text{ held constant}$$

Table I

FET Operating Parameters

FET Parameter	*Description*	*Vacuum Tube Equivalent*
BV_{GDO}	Drain to source breakdown voltage with the gate open-circuited	—
BV_{DSS}	Drain to source breakdown voltage with the gate short-circuited	—
$^*BV_{GDS}$	Gate to drain breakdown voltage with the drain short-circuited	—
BV_{GSS}	Gate to channel breakdown voltage with the drain and source shorted	—
C_{fb}	Feedback capacitance from drain to gate. Also designated C_{gd}	C_{gp}
C_{GS}	Gate to source capacitance	C_{gk}
$^*C_{is}$	Short-circuit input capacitance	C_i
$^*g_{fs}$	Forward transadmittance. Also designated g_m and Y_{fs}	g_m
g_o	Output conductance. Reciprocal of output resistance R_o	—
$^*I_{DSS}$	Zero bias drain current. Also designated I_o and $I_{D(on)}$	—
$^*I_{GSS}$	Gate to source cutoff current	—
R_{in}	Input resistance	R_{in}
R_o	Output resistance	R_o
V_{DS}	Voltage from drain to source	—
V_{GS}	Voltage from gate to source	—
$^*V_P$	Gate to source pinchoff voltage	—
Y_{fs}	Forward transadmittance, see g_{fs}	g_m
Y_{os}	Output admittance. Complex reciprocal of output resistance R_o	—

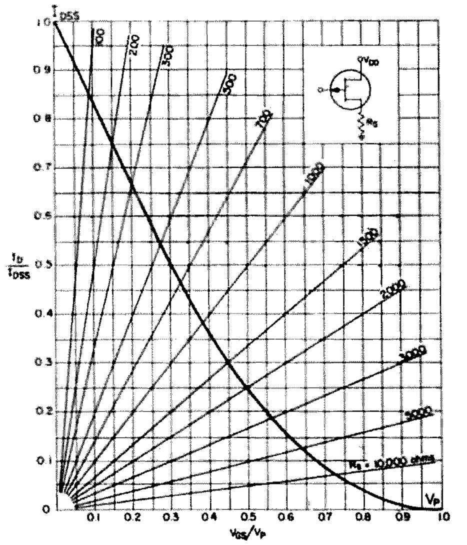


Fig. 6. Normalized FET transfer curve.

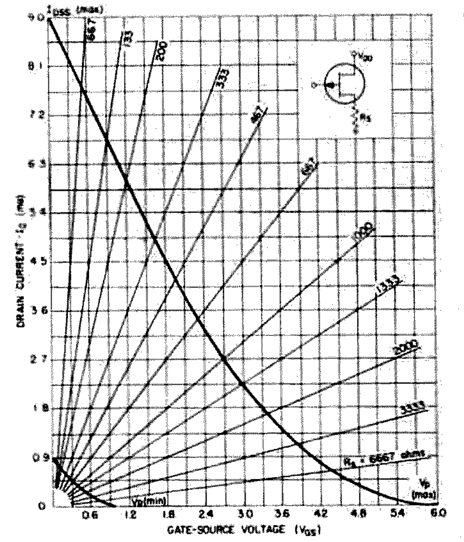


Fig. 7. U-112 transfer characteristics.

where g_{fs} is the ratio of the change in drain current to the change in gate voltage. This parameter is given in micromhos and is very useful in designing circuits.

The output impedance of the FET is the ratio of the change in drain voltage to the change in drain current with the gate voltage held constant. Mathematically:

$$R_o = \frac{\Delta I_D}{\Delta V_D} \text{ with } V_G \text{ held constant}$$

Since the drain current exhibits negligible change in the pinchoff region, even for rather large excursions of the drain voltage, the output resistance is essentially infinite under normal operating conditions.

In as much as the gate is normally reverse biased, the resistance at the input to the field effect transistor consists of a reverse biased diode junction and is typically on the order of several hundred megohms.

When the field effect transistor is used as an amplifier, it is usually used in one of the basic amplifier configurations illustrated in Fig. 5. The simple common-source circuit is the most popular however and will probably see the most use in amateur applications. The amplifier with the unbypassed source resistor is useful in some cases as an impedance transformer, but the voltage gain is very low because of the negative feedback across the source resistor. The source-follower is equivalent to the cathode- or emitter-follower and is used for the same purposes.

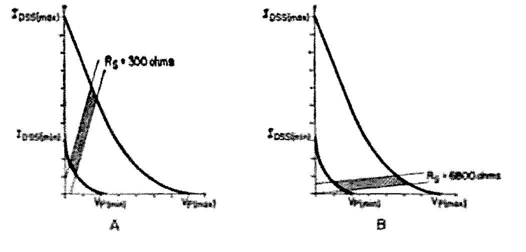


Fig. 8. Effect of source resistor on FET bias point.

Of particular interest is the cascade circuit using a field effect device in conjunction with a conventional transistor. This circuit is especially useful for coupling a very high impedance driving source to a low impedance load.

The values given in Fig. 5 for voltage gain (A_v), and input and output resistance are not 100% accurate, but are very close approximations which are useful in selecting circuits and transistors for different uses.

Irrespective of the characteristic gate voltage versus drain current curves (Fig. 3), the transfer characteristics of the FET is probably the most useful tool available for amplifier design. FET's manufactured by the diffusion process (nearly all of the types currently available) exhibit a transfer characteristic in the shape of a parabola as shown in Fig. 6. Regardless of the type, any field effect transistor may be force fitted to this curve by using the published values of pinchoff voltage (V_P) and the zero bias drain current (I_{DSS}). Since the curve plotted in Fig. 6 is "normalized," it may be applied to any FET by the proper use of ratios.

To apply this curve to a particular transistor, the published values for V_P and I_{DSS} are noted on the chart at the 1.0 points respectively on the horizontal and vertical axis. Then the values for the other points along each axis are calculated by simple ratios. For instance, if the published value of pinchoff voltage is 6 volts, this would be plotted on the normal-

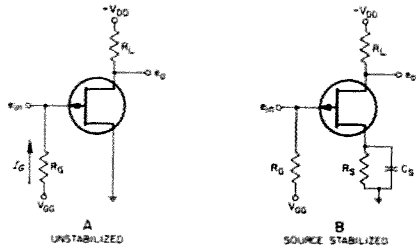


Fig. 9. Biasing FET amplifier stages.

ized V_{GS} axis at the 1.0 mark corresponding to V_P. Then the 0.9 mark on this axis corresponds to 5.4 volts (0.9 x 6 volts), 0.8 to 4.8 volts, 0.7 to 4.2, etc. The values of drain current along the vertical axis are determined by the ratio of normalized points to the published value of I_{DSS}.

The d-c load lines plotted in **Fig. 6** for various values of source resistor R_S are also in normalized form and must be converted for compatibility with the actual values plotted on the I_D and V_{GS} axis. This is accomplished by multiplying the normalized value of R_S by the ratio V_P/I_{DSS}. For example, if the published value for V_P and I_{DSS} are 6 volts and 9 milliamps respectively, the required factor would be V_P/I_{DSS} = 6 volts/9 ma = 0.667, and the normalized 1000 ohm source resistor would have an actual value of 667 ohms. Using this approach, the complete transfer characteristic of the Siliconix U-112 field effect transistor was plotted in **Fig. 7** using the published values for V_P and I_{DSS} along with the converted R_S bias lines.

The easiest way to use this normalized transfer characteristic chart is to use a clear plastic overlay and a grease pencil. In this way the chart may be used many times without damage.

It should be noted that actually two transfer curves are plotted in **Fig. 7**; the "main" curve for the maximum published parameters while the other curve corresponds to the minimum parameters. It is very difficult to control the operating parameters of the FET during manufacture (that's why they cost so much) and usually there is a rather wide variation between the minimum and maximum parameter values. This is pretty obvious from the curves plotted in **Fig. 7**; all U-112 field effect transistors will fall somewhere between these two curves.

When designing an FET amplifier circuit, it is helpful to plot both the minimum and maximum transfer curves; when this is done it becomes graphically evident which values of source resistance are most desirable. In the

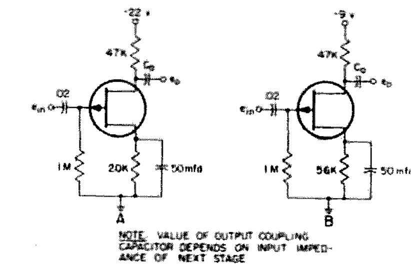


Fig. 10. FET audio amplifiers.

case of the U-112, a value of 667 ohms would place the quiescent operating point in the approximate center of the transfer curve. At first glance it might appear desirable to use this source resistor, but this is not necessarily so. Since the drain current with a 667 ohm source resistor could possibly vary from 450 microamps to 3.5 milliamps and still be within the minimum and maximum parameters of the FET depicted in **Fig. 7**, selection of a load resistance and voltage supply that would satisfy every FET of the same type would be nearly impossible. Consider **Fig. 8** where the effect of two different source resistors is plotted. In **8A** the 300 ohm resistor provides a worse condition than one that places operation in the center of the curve. The shaded area takes into account the 10% tolerance of standard resistors so operation could be at any point in this area. On the other hand, the 6800 ohm resistor in **8B** is nearly parallel to the horizontal axis, so variations between transistors have a minimum effect on drain current. Selection of load resistors and power supplies would therefore be infinitely easier with the 6800 ohm source resistor.

In addition to parameter variations, biasing at the input must be carefully considered. To obtain reasonably stable operation, a d-c path must be provided from the gate to the source. At room temperature, the gate current may be as low as four billionths of an ampere (4 nanoamperes), and the value of the gate resistor will be on the order of several megohms. However, as the ambient temperature increases, so does gate current and without adequate stabilization, this change in gate current will seriously effect the operation of the amplifier.

The simplest type of FET amplifier is illustrated in **Fig. 9A**. The voltage at the gate is simply the gate voltage supply (V_{GG}) minus the voltage drop through the gate resistor. Assuming a 10 megohm resistor at R_G, a supply voltage of 0.5 volts and gate current (I_G) of 4 nanoamps at room temperature, the voltage at the gate is

$$V_G = V_{GG} - (R_G I_G) = 0.5 - 0.04 = 0.46 \text{ volts}$$

However, if the temperature increases significantly, it would not be entirely unlikely for the gate current to increase by a factor of ten to 40 nanoamperes. In this case the voltage at the gate would be

$$V_G = V_{GG} - (R_G I_G) = 0.5 - 0.4 = 0.1 \text{ volts}$$

This is a considerable change in gate bias which would drastically effect the voltage gain of the circuit. In some applications it might be tolerable, but usually more stable operation is desirable.

In the circuit in **Fig. 9B**, bias stabilization is obtained by negative feedback due to the voltage drop across the source resistor. This is the same type of feedback provided by the emitter resistor in conventional transistor circuitry or the cathode resistor in tubes.

Because of the stringent requirements on field effect transistor biasing and the wide variations in operating parameters of devices currently available, amplifier design is somewhat of a problem. There are two distinct paths which may be taken; that of selecting a large value source resistor which provides a bias line parallel to the horizontal axis of the transfer characteristic and making the circuit "play" in true experimenter fashion, or go through a more rigorous mathematical approach that will get you close to the desired result before you even warm up the soldering iron. Although the approach you take will depend entirely upon your own desires, hopefully the result will be the same.

In the "experimenter" approach, a source resistor is chosen as previously noted and other circuit components are plugged in as seems appropriate. If you are familiar with vacuum tube circuits, the gate resistor and load resistor are chosen in just about the same way, with the load resistor chosen for voltage gain and the gate resistor for input impedance. Then a voltage compatible with all the voltage drops in the resistors is applied. If the completed circuit doesn't work properly, the source and drain resistors are juggled back and forth

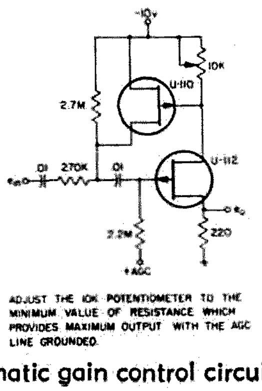


Fig. 11. Automatic gain control circuit.

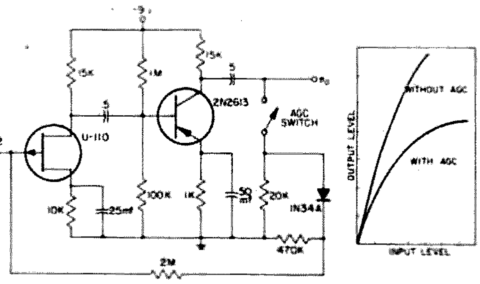


Fig. 12. Audio amplifier with AGC.

until desired operation is obtained. Actually in practice this can be done in less time than it takes to write about it. There is only one thing that must be considered before applying voltage to a FET circuit designed in this way; that is to insure that the voltage across the transistor does not exceed its breakdown voltage. The simplest solution here is to use a voltage supply with a maximum voltage somewhat less than the specified breakdown voltage of the device being used.

The best way to illustrate the use of the mathematical approach is to design a simple audio amplifier using the U-112 field effect transistor. Suppose that the requirements for the amplifier are

Supply Voltage (V_{DD})	22 volts
A-C Load Resistance (Z_L)	20000 ohms
Minimum Output Signal ($V_{pk\ min}$)	2 volts p-p

The drain resistor may often be chosen arbitrarily, particularly when no output resistance requirement is made of the amplifier. It is common practice in transistor circuitry to use a value about twice the a-c load so in this case 47 kilohms will do. The equivalent a-c resistance of the 47 K drain resistor and the 20 K load resistane is their parallel equivalent of 14,000 ohms. The quiescent drain current may then be calculated from

$$I_{DQ} = \frac{\text{output signal (min)}}{\text{AC load impedance}} =$$

$$\frac{2\text{ v p-p}}{14\text{ K ohms}} = 0.143\text{ ma}$$

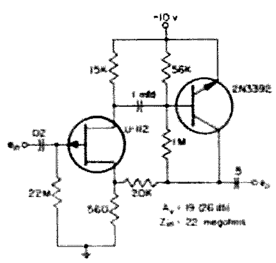


Fig. 13. High impedance preamplifier.

To prevent the transistor from operating near cut-off, about 50% should be added to this value; that is, $I_{DQ} = 0.214$ ma. The next step is to find the lowest value of source resistor that will satisfy the quiescent drain current requirements and breakdown voltage limitations and still keep the circuit operating in the linear pentode region. For the U-112, 6 volts across the transistor (V_{GS}) will ensure operation in this region. The minimum value of source resistor may be found from

$$R_S = \frac{V_{DD} - V_{GS} - I_{DQ}R_D}{I_{DQ}} =$$

$$\frac{22 - 6 - 10}{0.2\text{ ma}} = 20\text{ K ohms}$$

This is the minimum value of source resistance that should be used in the circuit under the intended operating conditions. A larger value could be used, but anything smaller than 20 K will be likely to place operation in the cutoff region, resulting in distortion of the output signal.

The value of the gate resistor may be chosen somewhat arbitrarily but from a mathematical point of view, there is a maximum limit on the value of this resistor dictated by the zero bias gate current (I_{GSS}). At room temperature, I_{GSS} for the U-112 field effect transistor is specified to be 4 nanoamperes, and the maximum gate resistance is given by

$$R_G = \frac{R_S\ (I_{DQ} + I_{GSS})}{I_{GSS}} =$$

$$\frac{20\text{K}\ (0.213\text{ ma} + 4\text{ na})}{4\text{ na}} = 42.6\text{ megohm}$$

This is the maximum limit on the gate resistor, but any smaller value may be used if desired. In this amplifier a one megohm input impedance will be more than sufficient so a 1 megohm resistor will be used.

The completed audio amplifier is illustrated in **Fig. 10A.** The coupling and bypass capacitors for field effect circuits are chosen in just about the same way as for vacuum tubes, so we won't discuss them here. The circuit in **10B** is a similar amplifier designed by the "experimenter" approach for use with nine volt batteries. Note that the only difference between the two circuits is the value of the source resistor. Bench tests on both these units showed that the only significant difference between them was the greater dynamic range of the circuit with the 22 volt supply. This is because with the 22 volt supply, a greater

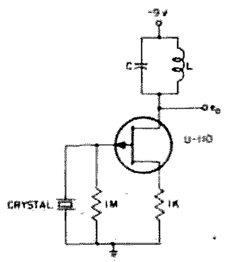
voltage exists between the drain and the source of the transistor, and it takes a much larger signal to drive it into cutoff.

Although it is impossible to cover all the applications of this versatile device in one article, some of the more obvious and straightforward applications are shown in **Fig. 11** through **15.** Besides the rf applications which are limited to about 10 megacycles or so with inexpensive FET's, the AGC amplifiers are particularly interesting. The operation of these circuits is based upon the fact that the transadmittance varies with different values of gate bias. In the AGC circuit illustrated in **Fig. 12,** two stages are employed to obtain sufficient voltage to control the gain of the first stage. The output voltage is rectified and fed back to the gate of the FET.

Two field effect transistors are used in the 60 db AGC circuit shown in **Fig. 11.** Here the positive control voltage is obtained from an external source. The variable resistor is adjusted to a minimum value such that the output voltage is greatest when the AGC voltage is zero.

The high input impedance amplifier in **Fig. 13** exhibits a voltage gain of 26 db and an input impedance of 22 megohms; the output resistance is on the order of 16 kilohms. This circuit makes an excellent high impedance microphone preamp for driving transistor circuitry. Operation of this particular circuit changes very little with voltage supplies from nine to about fourteen volts; it would be particularly well suited for mobile operation. Although the schematic shows a minus ten volt supply, the circuit will operate just as well with the —10 volt terminal grounded and the grounded end tied to a positive voltage supply.

The rf oscillator circuits illustrated in **Figs. 14** and **15** are field effect transistor adaptations of standard vacuum tube circuits and illustrate the circuit similarity between the two different devices. The variable oscillators in **Fig. 15** are especially noteworthy because they bring up the possibilities of VFO's, "gate" dip oscillators and the like. In both of these applications the FET version is considerably



BAND	CAPACITY	INDUCTANCE	J W MILLER NUMBER
160 M	100 pf	51-102 µh	4313
80 M	100 pf	12-20 µh	4310
40 M	50 pf	7-12 µh	4309
20 M	22 pf	4-7 µh	4308

Fig. 14. Crystal oscillator.

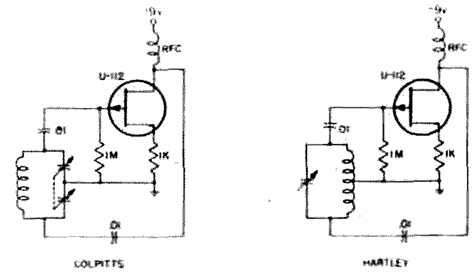


Fig. 15. FET oscillators.

more simple than their junction transistor counterparts.

At the present time selection of field effect transistor for a given application is pretty much dictated by how much you are willing to pay. However, for a given voltage supply, voltage amplification is inversely proportional to the pinchoff voltage. Therefore, devices with low pinchoff voltages are usually more desirable. The frequency response of the FET is dependent upon the amount of capacity at the input to the device, so small capacitances are a necessity for high-frequency applications.

There are only a few field effect transistors currently on the market which will appeal to the amateur fraternity. Foremost among these are the U-110 and U-112 transistors offered by Siliconix*. Until December 31, 1965, Siliconix has a special package deal for amateurs and experimenters that includes a U-110 for one dollar, a U-112 for two dollars or the pair for $2.75 plus local sales tax if you are a resident of California. The package includes application data and some sample circuits. After the first of the year the price of the U-110 and U-112 will return to their normal prices of $5.25 and $4.55 respectively.

Other devices of interest are the Texas Instruments 2N3819 and 2N3820 at $3.75 and the Siliconix U-146 ($3.25) and U-147 ($2.95). These are a far cry from the one dollar variety though and the Siliconix deal is especially enticing. A technological breakthrough may bring the price of the FET down tomorrow, but more likely it will be four or five years before the 50¢ FET is a reality. However, that is no reason not to try them now. After using them a few times, their advantages become immediately apparent. With the FET, nearly any vacuum tube circuit may be transistorized by simply changing the value of the cathode (source) resistor and lowering the voltage supply. So don't procrastinate, get on the FET bandwagon now.

. . . WA6BSO

*Siliconix Incorporated, 1140 West Evelyn Avenue, Sunnyvale, California

A Doll for Serifina

Ken Cole W7IDF
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The road from the docks to the Luzon village of Santa Marta was slick with mud, and in a drainage ditch a burned-out, rusting Japanese truck raised an eloquent frame against the fading sky.

In two minutes the jeep would pull up in front of Delgado's Bar, and under Victor's room. There, only a few years before, a boy of sixteen had found pleasure in sending to a stranger in America messages that, week by week, wove into a bond of friendship the pattern of his family, his village and his dreams.

Later, with the addition of Jiro Ohtsuka, those schedules brought closer together Santa Marta, Seattle and Yokohama, and they endured until shortly before the outbreak of war

In the last uneasy months of peace, I left school to go to sea on American Mail Line freighters that called at Yokohama, Shanghai, Hong Kong and Manila, and returned by the same route. Rarely did we spend more than two nights in port, but the schedule gave me an opportunity to visit with Jiro twice each trip, and occasionally we added an overnight run from Manila to the ore docks at Santa Marta. Victor Delgado would be waiting at the foot of the gangway.

With each visit I learned a little more of Victor's history. His mother had died when he was seven or eight, and shortly afterward his father had left him and his younger sister in the care of an aunt and spent five years making a modest stake in Stateside canneries. In 1937 the elder Delgado returned to Santa Marta to open a small bar and restaurant and raise his children. The hard years in an America struggling to climb out of a depression had been a gainful exchange; when Pedro walked down the steerage gangway at Manila he brought home with him an unyielding loyalty to the United States, a resolute optimism and, it must be added, an outsize appetite for salami. Soon enough the misfortunes of war would test all of these.

Now, recalling better times when I had arrived at the village with a salami for Pedro, radio parts for Victor, and a Japanese doll from Jiro for Serafina, I lacked the nerve to ask my driver for a rundown on the wartime fate of Santa Marta. In Yokohama the news had been good—Jiro had survived four years of service and was working as an interpreter for the occupation forces at Yokosuka. But here, in view of Pedro's independence, history of residence in the States, and his predictable opinion of the Co-Prosperity Sphere, I wondered if ultimately the Delgado family had not found itself trying conclusions with the Japanese army.

Victor was coming out of the restaurant just as we drove up, and he recognized me immediately. Even in the exuberance of our meeting we looked closely into each other's face—a war had taken away the years since last we met. In the shadows I could not see too clearly, but once inside my pleasure was mixed with a sadness I could not hide. The thin, expressive face I remembered as untroubled, always smiling, now was older and lined. A scar marked one arm, and I noticed that Victor limped.

He read my thoughts, "Yes, we had some difficult times here, and much fighting in the last days. But our family was fortunate; we are all alive. Now we only look ahead and try to forget the past. My father is in Manila arranging supplies for the village, and Serafina is in school." He laughed, "Look—American coffee for you! We have a dozen of your soldiers staying here and they give us their food to cook for them. 'Help yourself,' the sergeant told me, 'there will be plenty.' "

We were sitting in the small dining room. The floor was concrete covered with fibre mats. Along the front and one side were windows with shutters but no glass, on the other side a doorway opening on an outside staircase, and to the rear a passageway lead-

ing through the kitchen to a small courtyard. On the second floor were four bedrooms and above them a rusting iron roof. The beat of rain drummed from the metal sheets and I remembered it had rained like this every time I had been there. The shutters were open but the wide eaves sheltered the windows from the downpour. While Victor was bringing the coffee I counted seven small lizards on the walls and ceiling. Bright-eyed motionless creatures a finger in length. Official flycatchers.

I was curious to hear Victor's experiences for I already knew he had been involved in liaison on this part of the coast between holdout groups in the hills and agents landed from submarines. So far he had volunteered nothing and I didn't feel like probing painful memories. When he came back to the table we sat in silence for some minutes.

There was something I wanted to know, but I was uncertain about how to begin, so I asked Victor for news of Serafina.

"She is fine! A year ago she was very sick with fever and bad food but now she is well, and growing up so quick! You would not know her. Tomorrow my father will see her at the convent school."

In other days there had been a very gaudy jukebox in the dining room. A record by the Argentine, Pedro Vargas, had been Serafina's favorite, and I would give her a handful of silver to see her toddle across the floor. She could barely reach the coin slot then.

"What happened to the jukebox?"

"Oh, we used the parts in our radio equipment." Victor was thoughtful for a moment, then he said, "But let me tell you about Serafina—she saved us all, and in a way it was because of you."

Victor told me that just before Luzon was liberated the Japanese became concerned about an increase in guerrilla activity in the hills east of Santa Marta. Through bad luck and negligence, bearings were taken on clandestine signals by counter-intelligence direction-finders. The Japanese were determined to find the communication link, and one afternoon three trucks drew up in front of Delgado's place. Soldiers surrounded the building and machine guns on the trucks were uncovered and trained on the second floor windows.

Victor thought the end had come. Earlier in the day a warning had leaked through to the village—not an uncommon occurrence, for these investigative actions were not characterized by tight security. However, this weakness was of little aid to the quarry, for light aircraft patrolled the selected zone at low level and any movement could be spotted quickly.

While the village waited, a lieutenant wearing on his left arm the Kempei band took a sergeant and a squad into the restaurant. The officer ignored the Delgados and ordered the non-com to take four men and search the second floor. While the party thumped around overhead the rest of the men covered the rear court and the officer waited in the kitchen. When the second floor was cleared the soldiers came down and were put to work checking the kitchen and dining room, walls, floors and ceilings. Nothing was overlooked and nothing was found.

The lieutenant stared impassively at Pedro Delgado for an unnerving minute. "We know you speak English and we know you have a forbidden wireless set here. Show me where it is!"

"No! There is nothing! Look everywhere—you will find there is nothing." Delgado's voice was firm, but he was shaking a bit inside.

Suddenly a soldier came running from the kitchen passage. In one hand he held a shovel, and before he could speak the officer brushed by him headed for the courtyard. Prodded by rifle butts the Delgados followed. Soldiers were examining the ground, and the lieutenant was scraping the surface with one boot as if to emphasize the obvious fact that the packed earth had recently been swept. He turned to Pedro.

"Where did you bury the wireless?"

"There is no wireless!"

The sergeant told one of his men to find a bucket of water, and when it was brought he carefully sluiced it across the ground, beginning at one wall and working toward the center of the court. Where the fifth bucketful hit the earth the water soaked in swiftly, and without waiting for an order the soldier who had found the shovel began to dig. Pedro, Serafina and Victor were ordered to stand against the wall and the atmosphere became very unfriendly. Victor reached carefully for Serafina's hand.

The hole was only a foot or so deep when the shovel hit something. One of the soldiers dropped to his knees and scrabbled in the loose dirt. Then there was a moment of stillness and Victor heard what sounded like a snicker. The lieutenant leaned over the hole and was handed a broken box and a badly mangled doll. Serafina began quietly to cry.

The situation had to make sense, and Delgado tried. "Sir, it is my daughter's. The doll was run over by a truck."

Silence.

The officer's incredulity was plain. He ex-

amined the doll thoroughly and paid no attention to Pedro, who continued, "The doll was much loved by my daughter, and she was very ill with fever. When it was destroyed she said we would have to give it proper burial. A child's wish . . ." He shrugged, imploring agreement, "A harmless sentimentality. I could not refuse."

The lieutenant turned his attention from the doll to the girl. In her face were the signs of illness and malnutrition, pathetic confirmation of that much of her father's story. The tearful eyes were fixed on the tiny grave. Noting this, Pedro felt a bead of perspiration trickle down his back and he forced himself to smile at her.

Abruptly, and without a word, the lieutenant handed the doll to Serafina. Turning to the soldier who had been digging he gave a command. The shovel dropped beside the hole and the soldier followed the officer through the building to the street.

With an unsteady hand Pedro pulled Serafina to him and they all listened while the trucks roared and rattled out of Santa Marta.

Victor paused in his account, and when his thoughts returned to the present he held one hand a foot above the table. "If they had dug that much further they would have found the transmitter." Then he added, "And grenades. There had been so little time to find a hiding place. We relied on a trick, and prayers."

"It's hard to imagine the ground ever being dry here," I said.

Victor nodded, "Bad luck."

I wouldn't call it that, I thought, and held my cup out for a refill.

His eyes were grave as his thoughts turned again to the past. "Your being here makes me think of our friend Jiro," he said. "I wonder what happened to him? I'm so sorry we never met."

I was glad to hear that. "Well, Victor," I said, putting on the table a small box I had brought from Japan for Serafina, "You did."

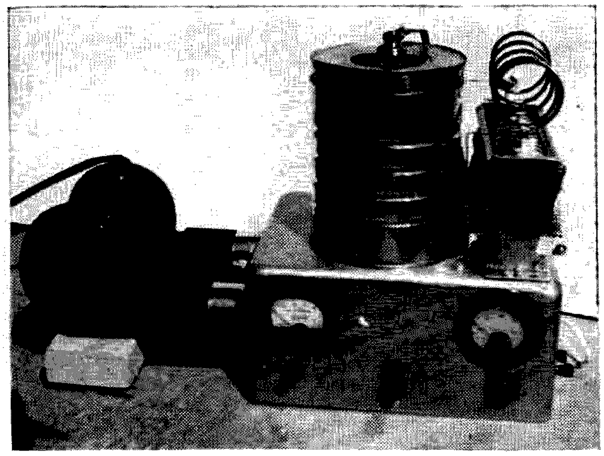
. . . W7IDF

4-1000's are cheap;
Their sockets are expensive.
So—

R. E. Baird W7CSD
3740 Summers Lane
Klamath Falls, Oregon

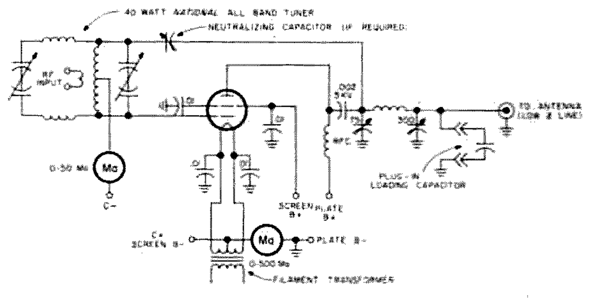
Build Your Own 4-1000A Socket

In this day and age there are an awful lot of TV stations using 4-1000As. When their emission drops to a certain level they are no longer suitable for the service, particularly at the normal power input. These tubes are usually still capable of a full kw input however. This writer obtained a couple free. Other hams could no doubt do likewise; at any rate, it shouldn't be very hard to buy one for $10 or so. The 4-1000A makes a nice stable final amplifier at about any frequency you want to operate. Due to the peculiarities of the circuit we built, neutralization was not even necessary. At 50 mc or 144 mc some attention would have to be paid to this problem, no doubt.



The basic problem in trying to build a cheap kw using a tube of this kind is the tube socket and air system. You also need a husky filament transformer, but rewinding a secondary on some existing one is relatively simple. We took what used to be a 12 volt transformer rated at 250 watts, wound on some number 10 wire, and wound up with 8 volts on the 4-1000A. This seems about right for a tired 7.5 volt filament. But the air system is something different. To begin with, the standard 5 prong socket costs a small fortune. Then to get satisfactory circulation you need a chimney around the tube. And any way you look at it you do have to have a blower.

Solution: We had a double ended blower on hand. A single ended one would do equally well. This we connected through short sections of rubber hose to holes in the chassis. The hose would just press inside a soup can which in turn was bolted to the chassis. It is very handy to have access to a good punch for all the holes you have to cut in a process like this; we had a hydraulic one.



4-1000A AMPLIFIER

For screen grid and grid prongs we cannibalized an old 304TL socket. With the ring part removed, the fitting fits very snugly. Screw-on clamps (like hose clamps) were used for the filament connections. The tube itself is held upright by a ring clamp that has four feet bent out on it and bolted to the chassis. A glass chimney was not available but it was discovered that a #10 tin can is about the right size; so one end was removed and a hole the same as the one in chassis was punched in the other. The bolts in the ring clamp, on the tube, go through this #10 can, the feet on the ring, and the chassis and thus secure the whole assembly. A second #10 can underwent an operation with the tin snips and hole punch, and by serrating the lower portion, it was possible to press fit it into the first can and form the desired chimney. This does of course increase the plate to ground capacity, and very little tank capacity is needed on 15 meters. The cooling system seems quite adequate and except for

the blower, costs nothing but labor. The illustration shows the procedure.

Circuit: The circuit diagram is included but is pretty straight forward. The chassis was a box that was on hand and lends itself well to a sub-chassis grid and filament circuit. The grid circuit is a National 40 watt all band tuner which happened to be on hand from previous equipment. The final tank coil is old fashioned for reasons of economy and space. You have to change it. A neutralizing capacitor is included using "grid" neutralizing. The geometry of this construction called for less capacity than was present with this capacitor completely removed to get perfect neutralization. So we had to take it out. The amplifier is perfectly stable for all frequencies from 21 mc down. Ten meters was never tried. At low frequencies it is necessary to add externally to the loading capacitor. The output terminals are binding posts with built in banana jacks. They are spaced so that a standard mica capacitor, with banana plugs screwed in, will just fit.

Use: The amplifier is used at W7CSD mostly on 21 mc NBFM with about 400 watts input. (We don't have a 3000 volt supply.) It would work at a full kw as a linear either for AM or SSB. A 6146 will drive it very nicely. The lack of a shielded cabinet may cause some eyebrow raising. At the W7CSD location there is only one TV station and it is on Channel 2. All others are received on a cable system; hence TVI is no problem. We have some herring bone on the TV whose antenna is less than 15 feet from the transmitting antenna when the transmitter is on 20. No trouble on 15 or lower frequencies.

Assuming you have an appropriate kw power supply gathering dust, this is a real cheap way to get a high power final on the air.

. . . W7CSD

Roy Pafenburg W4WKM

Simple Surplus Salvage

Twenty years ago, at the peak of the war effort, the twin sister of Rosie the Riveter dipped a socket drive set screw in the strongest cement then known to man. She then drove it home, using a 12″ "T" handled wrench and all the awe inspiring strength of her 200 pound frame. Her partner on the production line then stepped forward and, after inserting a tiny taper pin, drove it out of sight with the aid of a 20 pound sledge. After a liberal application of MFP varnish, this fragile item of electronic equipment was started off to the war. However, it never arrived and after reposing in many warehouses for all those weary years, you finally buy it from Surplus Sam.

Now you drool over all those fancy gears, couplings and other components you plan to incorporate into your new, super de luxe final. Out come the tools and you go to work. You insert a wrench in a set screw and apply pressure but nothing happens. You apply a bit more pressure and the wrench suddenly develops a 90° twist. Undaunted, you grab a pair of gas pliers and really heave. There is a slight click and the wrench turns freely in the broken screw head. Twenty minutes and much work later, you have the mutilated screw loose. Now to drive the taper pin out. Ten minutes, a broken punch, many bent nails and three cracked ceramic insulators later you hold the now multilated and utterly worthless coupling in your hand. You give up the project, turn off the lights and, once again, swear off surplus for good.

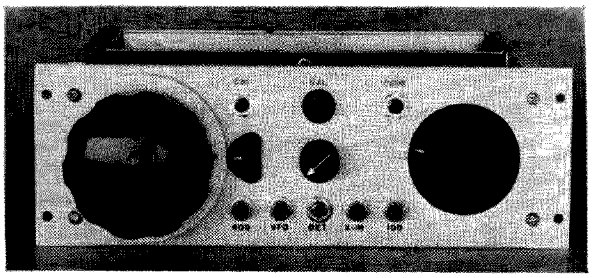
If the above sounds familiar, join the club. All who have worked with surplus military equipment have experienced this frustration. There is, however, an easy way out. Simply fire up the soldering iron before you go to work. When the iron is good and hot, insert the wrench in the set screw and apply moderate pressure. Now, bring the hot iron in contact with the hub of the coupling or other mechanical component and wait a moment. As the hub heats up it expands from around the setscrew and the screw turns out easily.

Now, let the hub cool off and turn your attention to the taper pin. Carefully examine both ends of the pin and turn the coupling so the small diameter end of the pin is toward you. Once more, apply the hot soldering iron to the hub. Let it heat for about 30 seconds and then, using a small drift punch (or even a rusty nail) tap lightly on the pin. The pin will drop out as if hexed.

The coupling, gear or what have you should now slide freely off the shaft. If not, do not be alarmed. Simply heat the hub again and tap lightly. The hub should slide off easily.

Try this technique; it works wonders. Only one precaution is in order. Use the heat treatment *before* you chew up the screw and round off the wrench with the brute force method!

. . . W4WKM



Tom Lamb K8ERV
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Mansfield, Ohio

An Audio Frequency Standard

The instrument to be described will measure or generate frequencies from 100 cps to 6 kc with an accuracy of a *few cycles*, and will generate harmonic markers of 100 and 400 cps with an accuracy of better than .03%. An instrument of this accuracy is particularly useful for calibrating other oscillators; measuring mark, space and shift frequencies in RTTY work; measuring inductance, capacity and Q by the resonant frequency method; and plotting the response curves of sharp audio filters.

Fig. 1 shows the block diagram and Fig. 2 the method of operation. A beat-frequency oscillator operates from 100 cps to 6 kc. The "F" dial (main tuning) is calibrated every 100 cps over this range. A second dial "δf" (vernier tuning) lowers the output frequency by up to 100 cps. An accurate fork standard establishes bench marks every 100 cps throughout the frequency range.

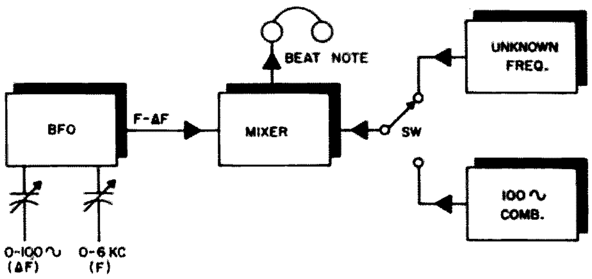


Fig. 1. Block diagram of the Audio Frequency Standard.

Suppose an unknown frequency (2170 cps) is to be measured. Fig. 2 shows the relations between the unknown, the bfo and the 100 cps markers. The bfo is first set *exactly* on the unknown frequency by zero beating. The "F" dial now reads between 2.1 kc and 2.2 kc. The switch (Fig. 1) is now thrown connecting the mixer to the 100 cps standard. The "δF" dial now drops the bfo to the next lower 100 cps harmonic (2.1 kc). The "δF" calibration says that the bfo was dropped 70 cps to reach 2.1 kc, so the unknown must be 2100 cps plus 70 cps or 2.170 kc. The unknown is always the sum of the "F" and "δF" dials. The entire procedure takes only a few seconds.

Since the 2.1 kc frequency is exact, the only sources of error are δF dial inaccuracy, inexact zero beating, and bfo drift during measurement. With a little practice the error should not exceed five cycles at the most. By measuring the harmonics of low frequency signals, this error may be decreased even further!

The complete circuit is shown in Fig. 3. Q_1 and Q_2 are stable beat oscillators operating at about 450 kc. L_1 and L_2 are the windings of 4.5 mc *if* transformers. The fixed tuning condensers C_1-C_2-C_{46}-C_5 must be made up of silver micas for stability, since even a very small percentage drift at 450 kc results in a very large drift in the beat frequency. The short term drift rate in the audio beat can

be held to about one cycle per minute. Of the many transistor types tested, the Philco 2N588 gave the best voltage and temperature stability, but almost any rf type will work in the circuit.

The oscillators must have good electrical isolation or they will lock together at low frequencies. C_8 must be connected with short leads to the common -6v line near the coil terminals. With proper isolation outputs of less than 20 cps will be obtained before locking.

Q_3 mixes the 450 kc oscillators giving a 0-6kc beat in the collector circuit. This bfo output feeds the second mixer, Q_4

Q_6 is a 400 cycle fork oscillator. The fork is rated accurate to better than .01%. Since the recommended (vacuum tube) circuit is not used, the accuracy may be lowered, but even .03% would be only 1.8 cps off at 6kc!

The output of Q_6 is a sharp pulse, ideal for triggering the unijunction divider. The pulse is clipped at 6.8 volts by D_2. This standardized pulse is available at an output jack, and is also used to calibrate the bfo at 400 cps when S_1 (cal bfo) is pressed.

The unijunction 100 cps oscillator, Q_5, is synchronized by the 400 cps fork. The 100 cps signal is available at an output jack. Its very sharp pulse provides harmonics every 100 cycles throughout the audio spectrum (Fig. 2). When S_2 is pressed, the bfo is combined with this frequency "comb" in mixer Q_4 to give accurate zero beats with the bfo every multiple of 100 cps.

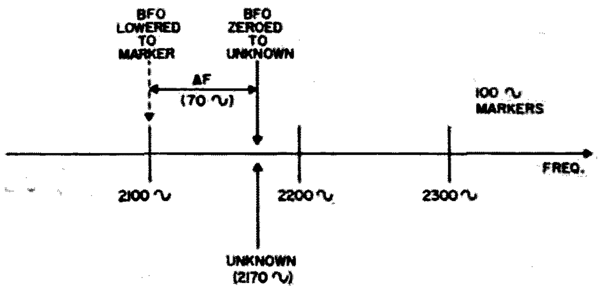


Fig. 2. Frequency relationships in measuring an unknown.

Note that the output of mixer Q_4 does not contain the usual low-pass filter. The audible frequencies present (bfo or unknown) are heard as well as any near zero beats. The very low beat frequency, which usually cannot be heard by ear, modulates the higher audible notes present, causing them to "wow-wow-wow." An exact zero beat can be easily established since we are listening, not to the sub-audible beat, but to its effect on a higher tone. The need for this higher audible tone sets the lower limit of the instrument to about 100 cps.

Calibration

It is important that the bfo not drift during initial calibration. Place the instrument away from drafts and hot equipment, and let it warm up for several minutes. Set C_9 at minimum capacity, set C_{10} at half capacity, and set C_{11} at maximum capacity. Now adjust the slugs of L_1 and L_2 for a strong zero beat in headphones or in an amplifier plugged

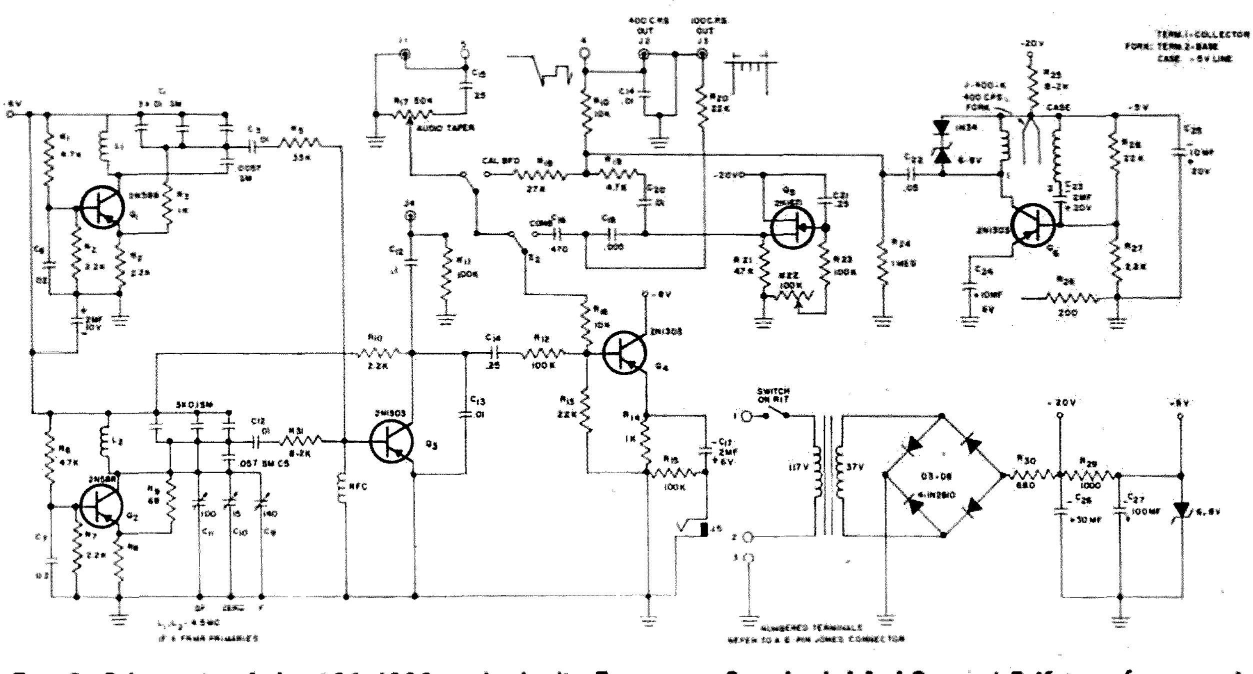


Fig. 3. Schematic of the 100-6000 cycle Audio Frequency Standard. L1, L2 are 4.5 if transformer primaries. Remove internal capacitors. T1 is a miniature 37 v transformer (available from author for $1.) The fork is a Philomon J-400-K. C5 should be .0057 and the three .1's above it .01's.

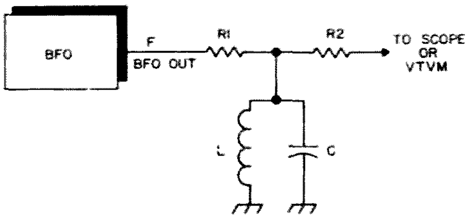


Fig. 4. Measuring L, C, Q.

into J_5. If a beat cannot be obtained, pad C_2 or C_5 until a tone is heard, and adjust the slugs for zero beat while tapping the coils to insure mechanical stability. The "F" dial (C_9) should now cover a range of about 6kc, with a good constant sine wave at J_4. The ampiltude may be adjusted for maximum output without distortion by changing R_5.

About 30 seconds after turn-on the fork should be heard softly humming. Connect a cope to J_8 and adjust R_{22} for a stable 100 cycle output, indicated by a strong Q_5 pulse on top of each fourth 400 cycle pulse. If Q_5 will not synchronize, change C_{29} as necessary.

Press S_2 and rotate C_9. Faint zero beats should be heard every 100 cycles. With C_9 set on one of the markers, C_{11} should be able to drop the frequency to the next lower marker, that is, C_{11} should have a 100 cycle tuning range. For best linearity, center this range so that C_{11} need not be operated too near either full or minimum capacity. Mark the two zero beat points on the "δF" dial *very carefully.* With mechanical dividers divide the scale into 5-cycle increments beginning with "O" at the higher capacity end.

Return C_{11} to the zero mark. Set C_9 to minimum capacity and reset L_1 for zero beat if necessary. Slowly turn the "F" dial to higher frequencies, with S_2 depressed, and mark the dial at each 100 cycle beat point. Return occasionally to the first 100 cps mark and re-zero with c_{10} if necessary. A particularly strong beat will be obtained at 400 cycles by

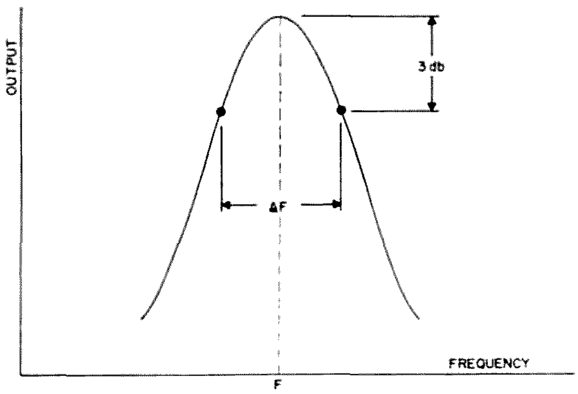


Fig. 5. Q calculation by the bandwidth method. $Q=F/\Delta F$

pressing S_1. Mark this point in red as it is a bfo calibration point.

Measuring an Unknown frequency

Turn R_{17} for minimum level with S_3 turned on. Set the "δF" dial to zero and set the "F" dial to the 400 cycle calibration mark. Press S_1 and set C_{10} for zero beat. Release S_1, advance R_{17} and with the "F" dial zero beat the unknown. Be sure you don't zero on a harmonic of one of the tones by audibly comparing the tone at zero beat with R_{17} at minimum (bfo tone) and at maximum (unknown tone).

With the "F" dial *accurately* zeroed to the unknown, push S_2 and quickly advance the "δF" dial to zero beat with the next lower 100 cycle marker. The unknown is now the next lower "F" dial reading plus the "δF" dial reading. Note that the exact calibration or reading of the "F" dial is unimportant, it just establishes which 100 cycle harmonic is being used as a reference for the "δF" dial.

Frequencies above 6kc can be measured by beating a harmonic of the bfo if the approximate frequency is known. The percentage accuracy is not changed, but the inaccuracy in cycles increases in proportion to the harmonic number. Likewise, frequencies below 3kc may be measured more accurately by setting the "F" dial on the second (or higher) harmonic. Now the inaccuracy in cycles is decreased by the harmonic number.

Setting an exact frequency

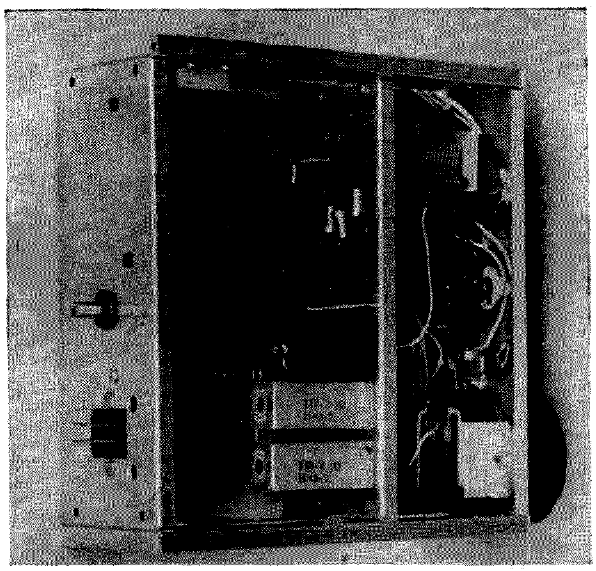
Suppose you want to generate an accurate 2125 cps signal. Set the "δF" dial to zero and calibrate the "F" dial at 400 cps. Push S_2 and zero beat the "F" dial at the next higher mark (2200 cps). Now drop the frequency 75 cps with the "δF" dial. The output is now 2200-75 = 2125 cps. When located away from heated equipment, the oscillator drift will be about 1 cycle per minute.

Uses of the standard

Now that you have decided not to build this standard, let's see what you will be missing. There are several unique measurements that can be made with an accurate oscillator.

L-C measurement

Providing the circuit Q is fairly high, very accurate measurements of L and C can be made by determining the resonance of an L-C circuit. Fig. 4 is set up using an accurately known inductance to measure capacity, and vice-versa. Resonance is indicated by a peak in the output on a scope or ac VTVM. Values are calculated by $F = \frac{1}{2\pi\sqrt{LC}}$



Side view of the Audio Frequency Standard. The fork is in the upper left corner. Notice that most of the wiring is on a printed circuit board, though other methods of construction may be used.

Q measurement

The Q of an L-C circuit is easily measured by the bandwidth method. The setup is shown in Figs. 4 & 5. The 3 db down frequencies are measured and the Q figured from $Q = F/\delta f$. The total circuit loading (R_1 in parallel with R_2) must be high compared to $2\pi FLQ$ for accurate results. If a low-loss condenser is used (mica or polystyrene) the Q will be essentially that of the inductance.

Filter measurement

Very sharp audio filters, such as used in RTTY, may be easily plotted because of the high accuracy and good setability of this oscillator. The output impedance is 2.2k, which must be corrected to the proper input impedance of the filter. An ac VTVM connected to the filter output will enable an excellent frequency plot to be made. Usually the "δF" is not needed, the "F" dial being set to each 100 cycle marker and output readings plotted.

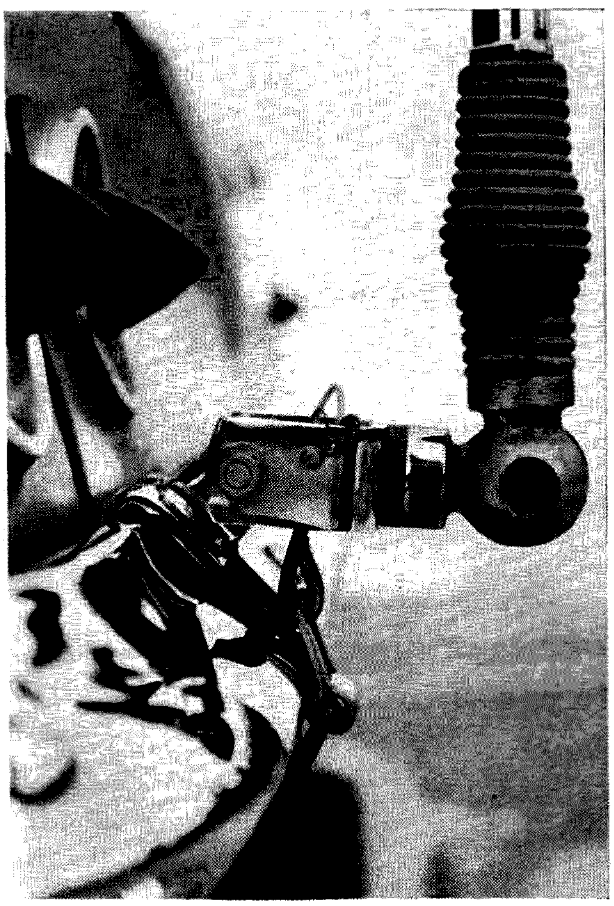
In RTTY work it is necessary to measure small differences of large numbers (0-850 cps out of 3kc), a basically inaccurate procedure. Finding the mark and space frequencies with this oscillator, and subtracting, is probably much more accurate than the normal zeroing of one frequency in the receiver and measuring the shift directly. The latter procedure is not too accurate due to the difficulty of getting a good zero beat with most receivers.

In the past month this instrument has become indispensable, and worth its small cost several times over in just the tuning up of RTTY filters. . . . K8ERV

Robert N. Tellefsen W7SMC/6
277B Tyrella
Mountain View, California

A Bumper Mount for "Impossible" Cars

After driving an older car equipped with a body mount for your mobile antenna, you have bought a new (or newer) car. Now what to do about an antenna mount? You don't want to put any holes in the body of the new car, at least not until it's paid for, and the bumper of the new car is too close to the body to permit the use of a conventional bumper mount. The bumper may even underhang the body. Certainly the base of your whip would touch the rear edge of the trunk lid or the tail lights. So where do you go from here?

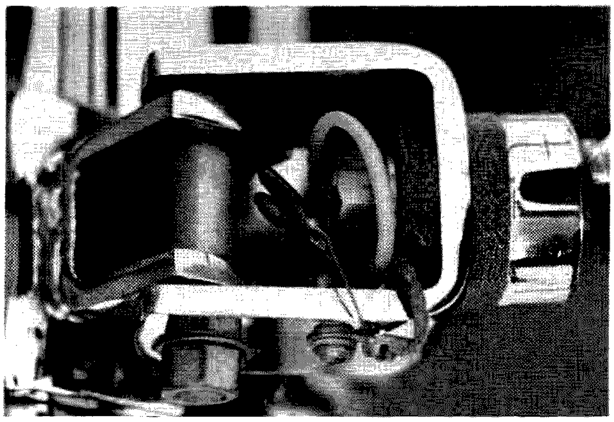


The hybrid bumper mount installed on the author's Duesenberg showing sufficient clearance even for cars where the rear deck overhangs the bumper.

If you kept the body mount from your old car, you have the problem halfway solved. All that remains is to purchase a good double-chain bumper mount, one with an inverted U-shaped bracket on which a whip is normally mounted. These two mounts are then combined to make a hybrid bumper mount which will give you plenty of clearance between your antenna and the car body.

To assemble this hybrid bumper mount, it is first necessary to remove the U-shaped bracket from the rest of the bumper mount for a while. This is done by removing a cross bolt and a spacer which prevents the legs of the U-shaped bracket from being drawn together when the cross bolt is tightened. In the middle of the U-shaped bracket there will be a pair of fiber washers with a bolt passing through them into a small hexagonal metal fitting which would normally receive the base of an antenna. Remove the metal fitting, the bolt, and the two fiber washers from the U-shaped bracket. Set the fiber washers and the U-shaped bracket aside; they will be used later.

Remove the big fiber disc from your old



Construction details of the hybrid mount. The two parallel capacitors are for impedance matching.

body mount. You should have remaining the two halves of the body mount, with the body-mounting half having a long screw protruding from it.

Now replace the two fiber washers on the U-shaped bracket, and insert the long screw of the body mount through them. If the long screw is a little larger in diameter than the holes in the washers, the holes can be enlarged with a drill or a rat-tail file. Be careful not to remove any more fiber material than necessary. Place a large solder lug on the end of the long screw and start a nut on the screw. Position the body mount and the U-shaped bracket as shown in the photo, and tighten the nut with a socket wrench.

Replace the U-shaped bracket on the rest of the bumper mount, and tighten the cross bolt finger tight.

Install the hybrid bumper mount in a convenient place on your rear bumper. Push the U-shaped bracket over so that it lies in the horizontal plane, and tighten the cross bolt so that the U-shaped bracket cannot move. Then adjust the joint between halves of the body mount so that the part which receives the base of the antenna will hold the antenna erect.

When you figure out a way to bring your coax out of the car body to the hybrid bumper mount, connect the center conductor to the solder lug on the long screw of the body mount, and ground the shield braid to the U-shaped bracket. Some bumper mounts already have a small screw tapped into the side of the U-shaped bracket for this purpose. If yours does not have such a screw, you can easily install one.

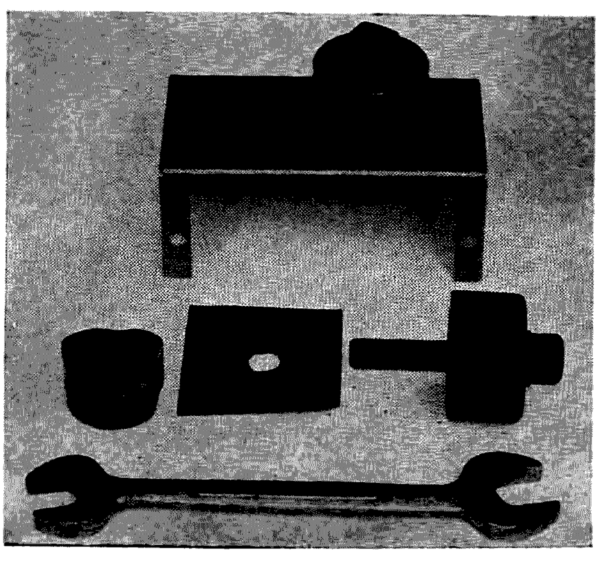
This hybrid bumper mount has been in use for over 7000 miles and has given very good service. If you have a new car, why not give this hybrid mount a try before cutting into that nice paint job?

. . . W7SMC

Roy Pafenberg W4WKM

Socket Punch Chassis Protection

Many commercially available chassis assemblies and cases are of light aluminum construction and finished in hammertone gray lacquer. Since no primer coat is used, this finish is very susceptible to flaking and chipping. Even when care is exercised, the finish is usually damaged during the construction of a project using these units.



The photograph shows the answer to one common cause of finish damage. When knockout socket punches are used, the pressure of the punch will often cause flaking of the lacquer. Simply insert a washer of cardstock or heavy paper between the punch and the chassis surface. This gasket will protect the finish, even if the punch turns as the screw is tightened.

Another common cause of finish damage is the square used to lay-out the chassis. To avoid this damage, simply apply a strip of cellophane tape to the underside of the rule and the butt surfaces of the square. After construction is completed and decals are applied, a coat of clear spray lacquer will protect both the decals and the original finish. *Warning* apply a very thin coat or the spray lacquer will dissolve both the decals and the original finish!

. . . W4WKM

Photo By: Morgan S. Gassman, Jr.

"DE" How Come?

I wonder how many of our present-day hams have thought about why they use "D E" before signing their calls when using Code?

"D E" was part of the 1912 International Radio Agreement. Since it has now been used for more than 50 years, it probably is taken for granted and used without a passing thought by all except the real old timers!

Before 1913 we just made the call letters of the wanted station several times, then the call letters of the calling station—no DE in between. For example, instead of calling say NPH NPH NPH de W6LM—we would send NPH NPH W6LM GA. The "GA" stood for "go ahead" as there also then was no "K" invitation to transmit!

I am certain the procedure explained above was simply a carry-over from the Morse land telegraph lines and stations. All instruments on a land telegraph line were in series; so, when a called station replied to a calling station, the operator just opened the circuit (with a lever provided for that purpose, on the side of the key) and answered back. Of course the calling station knew the moment the circuit was opened and reply started; so there was no need of any character or signal between the call letters of the 2 stations. The same procedure was used on wireless work until the 1912 regulations included the use of "DE."

. . . W6LM

John Carroll K6HKB

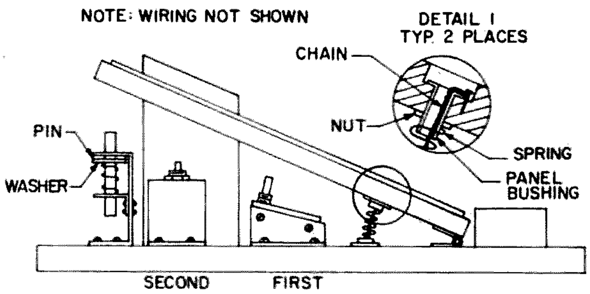
A Double Action Foot Switch

Foot switches to put the rig on the air aren't new, but they are usually the push-to-transmit, release-to-receive type. I decided to build one with the option of lock-on, so that I could have push-release action for short transmissions without the fatigue of holding the pedal down for long periods, and still have no-hands operation in both cases.

Referring to the drawing, the pedal is hinged to the base and provided with a return spring just stiff enough to raise the pedal. A chain limits the resting height as shown in Detail 1. The spring should be soft enough to go down easily when stepped on.

The two switches under the pedal are wired in parallel. The first switch is a momentary type, a microswitch with an overtravel plunger in my unit. This one provides the push-to-transmit action. The second switch is a push-on, push-off switch. It provides the lock-on feature. I used a common appliance switch.

The spring assembly under the toe of the pedal is made extra stiff, and the pedal



reaches it after the first switch and before the second one. Resting a foot on the pedal triggers the first switch only, giving push-release action. Stepping down hard triggers the second switch, which stays on after the foot is removed. A second stomp shuts it off again.

It's a good idea to put a heel rest behind the pedal, because the foot slides back otherwise. The foot rest next to the pedal is handy between transmissions.

As for construction and exact mechanical scheme, it's as far from critical as anything in radio ever gets. The dimensions and the shapes of the brackets just have to be laid out according to what's in the junk box. The base can be anything big enough to stay put; mine is a ½ × 7 × 10 piece of scrap plywood. I used an automobile gas pedal, but a piece of plywood covered with stair tread might be more comfortable. The heel rest is a piece of 1 × 2 tacked to the base, and the foot rest is a wedge-shaped piece cut from 2 × 4.

A couple of things are important. The pedal should still be tilted back 10° or 15° at the bottom of its travel, because it's hard on the ankle to reach down any farther than that. Also, there should be room to adjust the switches to get the sequence right.

I've been using mine for four months, and the only trouble I've had came from a worn-out vacuum cleaner switch I shouldn't have used in the first place.

. . . K6HKB

Gus Browning W4BPD

Gus: Part VIII

In the last chapter I was in Athens, Greece staying with SV1AB, George. We talked about the possibilities of a trip to Mount Athos. Socrates SV1AE was also interested in a trip there and both of them and a number of other hams had tried but permission was never given to anyone, nor was anyone even encouraged to keep trying. First, there is problem No. 1—getting permission from the Greek government, and problem No. 2—getting permission from the high church officials in Mount Athos. Getting permission from either, even to this day, seems absolutely impossible. The same goes with the Sovereign Order of the Knights of Malta in Rome. This has been tried, I understand, by a number of people, and so far it's still there awaiting the right one to get the right key to open it to the DX World as virgin DX territory. I would give my right eyeball to be the fellow who operates from these two spots, the only two spots in the whole world still left for a W1FH to work.

I felt, as I departed from Athens, that I had known George a long time. He is a very sincere fellow, and of course I hope some day to visit him and Socrates again and get to know both of them better.

The trip to Beirut, Lebanon was uneventful. No customs trouble at all there, since I was having my radio equipment shipped to Nairobi by I1AB of Milan. I was met at the airport in Beirut by Rundy and Fred—OD5CT and OD5AF. Rundy took me to his very elegant air-conditioned apartment and was introduced to his refrigerator with all those Cokes in it. Rundy's wife is from North Carolina, and boy I sure had some very fine southern cooking while there! I even operated OD5CT a number of times. I was getting the "feel" of DX now; the "W" boys were not loud like they were in Europe. The old bands were changing and so were the local QRM stations heard.

The population of Beirut seemed to be about three fourths Arabic and the rest Western. Hotels can be had for any price that you want to pay. Beirut is a sort of free port, so things can be bought there a lot more reasonably than any other place in that area except Aden. For a ham, Beirut seems to me to be a very good spot. All Africa is south of them; Europe is not too far away for good QSO's all day long. The Middle East is their next door neighbor; Asia proper is not too far away either. And of course the "WK" stations with their KW's and beams can be worked easily. I suppose their hard-to-work area is the Pacific Islands. But, all considered, OD5 land seems to be situated in a good spot, although living there is very expensive, Rundy told me. This is true especially if you want to buy USA products. I understand if you are a good "trader" that it's quite easy to make good money in Beirut. Everyone there looked quite prosperous, and business was like a beehive in every place that I visited. Even at the bazaars business was rushing like mad all day long and well into the night.

After about 4 or 5 days there staying with Rundy, we departed for Cairo, Egypt. The flight we went on arrived at about 10 o'clock at the Cairo Airport. When you get over Egypt you will know it by the desert down below you as far as the eye can see—it's one big mass of yellow sand from horizon to horizon. Then the plane landed and the door was opened; we knew we were in Egypt by the hot air. The airport at Cairo is out on the desert and the approach is sand in all directions. Rundy came with me to Cairo, to stay a few days for business. He insisted that I stay with him at the Nile Hilton, a real fancy hotel with real fancy prices; the whole thing is airconditioned and there is no suffering there on account of the heat, as long as you are inside the hotel. We went out to some of those Egyptian cafes and

had some of the oddest food I had ever eaten. Then one night we went to one of the night clubs. That was the thing! Arabic music, singing, and real "belly dancing."

After about 3 days or so, Rundy had to return to Beirut. After he departed I decided it was time to hunt up the fellow that Mahmud—SU1MS—had written that Arabic note to. I could not stand that rate staying at the Nile-Hilton so I made a phone call to the number that Mahmud had written. Immediately Mahmud's friend, Mohammed Atef, was around to the hotel to see me. He had a chauffeur driven red Chevrolet convertible and the top was down. He insisted that I come around and stay with him (this was what I wanted all along).

Mohammed owned a nice apartment building, I guess about 6 or 7 stories high. On top of the building was a penthouse consisting of three rooms. He went in with me and said, "Gus, this is yours as long as you stay in Cairo." Out of the bedroom window I could see the Pyramids of Giza in the distance, all three of them. I said to myself, "This is it." He told me if I wanted anything just to pull the tassel that was at the head of my bed. He departed and told me to lie down and take a rest. Immediately after he left I decided to try out that tassel. I pulled it and in a few moments a young servant appeared and said, "Yes, master?" I said, "Get me a cold Coca Cola." He bowed and departed and in about 5 minutes was back with a good cold one. Now this was living! About 12:30 my lunch was brought up to me by the same little servant. This boy was about 12 years old and, I understand, was one of the children from a farm family. After lunch I decided to try the tassel pull business again. When the servant said "Yes, master," I said, "Bring me a good cold Pepsi Cola"—pronto, it was on hand. I said, Gus, you are a lucky dog; all this service, plenty of cold drinks, 3 private rooms, and a car left at your disposal also.

Walking around Cairo, I saw lots of those veiled ladies and I was warned not to attempt to take a picture of them or my camera might get smashed and maybe I might even get smashed. I went to a number of those big mosques in Cairo. You see people praying on their prayer rugs, all facing the east—Mecca. This takes place 5 times each day, early in the morning, again about 10, then about 12 noon, again about 3, and again about 6. These mosques have gone modern with a bang—everyone of them seem to have a big P.A. system where the head man calls the people to prayer with his mournful singsong. To me it sounded very sad.

The first morning at Atef's I went downstairs to the chauffeur and told him I wanted to go to the pyramids. Off we went. The pyramids of Giza (those are the 3 big ones, that you always see in movies) are about 15 miles away, a good road all the way. When I first arrived at their base I was impressed with their tremendous size, and then I looked at those large stones that they are made of; and when I thought that they were made a few thousand years ago, I really wondered how they ever did this without any modern machinery—all done with just the simplest tools. It does look almost impossible, but there they are.

I had a few meals with Mohammed in his apartment below; he was living with his mother and family there. But one odd thing: I never did see any females there. It seems they are kept separate from the males. You soon get used to the fact that when you go to someone's home, you don't expect to see their wife, or any of their sisters; nothing but their father and brothers. This is their way of life.

One night someone knocked on my door and when I opened it, there stood one of the prettiest young ladies I have ever seen. She was about 14 years old and a picture of real beauty, with the typical Egyptian face. I said "Come in." She introduced herself as Atef's sister. I said, "Where is your veil?" She said, "I am a modern Egyptian and will never wear one of those old-fashioned veils." When I returned to Cairo 3 years later, I noticed there were a lot less veils on the ladies. This young lady spoke very good English and we had a long talk. She wanted to know all about America, and I told her what I could. To this day, I don't think Atef knows that his sister visited me when I was there.

While in Cairo I met SU1IC – Abrihim Charmy, a very nice fellow who is not on the air anymore. It seems that he received a notice from the licensing authorities to bring in his license. It was cancelled on the spot with no explanation whatsoever. They also came to his home and cut all the cables between his power pack and rig and it was all sealed up with sealing wax and an official seal placed on it. I asked him why. He said he had no idea why this was done. I guess in this sort of dictatorial country, they don't have to explain anything to you. When it's done, it's done—Amen! You fellows in real free countries don't know how lucky you are. In lots of countries they don't have to explain anything to anyone. If you do too much complaining you might even end up in prison. You just keep your mouth shut and take what they dish out. Boy, how lucky we Americans are—and many people don't know it. We take everything for granted and seldom think of how things are in the rest of the world.

After staying in my little penthouse in Cairo for 14 days, time arrived for me to depart for Nairobi. Atef was very disappointed that I had to leave. He invited me to return and spend a few months with him upon my return trip. I can truthfully say my stay in Egypt was most enjoyable. I really was "living" there: plenty of good food, auto trips, private rooms, and ALL FREE! What else could I have had?

The first place the plane stopped on the way to Nairobi was Khartoum, in the Sudan. I wanted to stay there for 3 or 4 days to take some pictures. The plane landed about 10 at night, and brother, when they opened the door, the hot-air blast scorched me. It was HOT and how! You know me; the way I travel is—never make any reservations at any time. Well, this is one time I should have made advance hotel reservations for an air-conditioned room! Since I had not, I ended up hunting all over Khartoum for one; none could be found so I had to accept a regular hotel room, one with two of those large, slow-turning ceiling fans in it. I took a shower, had dinner, took a shower, wrote some in my diary, took a shower, read a newspaper and took a shower, and without bothering to put on any clothes at all, lay down on just the bed sheets, both ceiling fans in high gear, and tried my very best to go to sleep. Sweat poured off me like a dog. I just lay there sweating it out until about 2:30, when it finally cooled down to about 100 degrees and I went to sleep. I was up at 7 the next day, and it was already hot. I could not see anything at all in Khartoum to take any pictures of; there just was not anything that looked interesting enough for me to use my film on. My plans were to stay there for 3 or 4 days, but with the weather so doggoned hot and nothing of interest to look at or visit, I decided Khartoum was not for me. Immediately I departed from there for Addis Ababa, Ethiopia.

Between Khartoum and Addis Ababa I saw some of the roughest country I have ever seen anywhere; plenty of big mountains and lakes. At one place during this flight I saw three lakes, each one a different color; one was blue, one green and one yellow. I took a color picture of this from the air, and as usual it did not turn out so good.

The airport at Addis Ababa was practically brand new, very beautiful and large. I spent one night in Addis Ababa, walking and taking a few pictures around the Palace and a few street scenes. The weather there was very nice, the elevation being something over 1 mile.

Away I went on to Nairobi, Kenya—lion country I call it. The first night there I spent in a downtown hotel. I called up Leny VQ4AQ (now 5Z4GT) and he came by and took me to his home where I met his niece XYL Lillette and his daughter Gertie. We had a wonderful eye-ball QSO. I operated VQ4GT for a number of QSO's. George VQ4AQ and Robbie VQ4ERR came out to visit us and a very fine time was had by all. After spending one night with Leny, I found out that I had slept in Gertie's room and she had slept on the couch in the living room. I decided that I did not want to impose on them, and after talking to George, I was invited to come and stay at his house a few nights while we were QRX for the WØ boys to show up from Kansas City. I found that George was a real down-to-earth fellow and would do anything for a fellow ham; the same went for his FBXYL. They really made me feel welcome in their home. George drove me all around Nairobi, even a few trips out to the Game preserve that is just outside the city limits of Nairobi. There were plenty of lions, elephants, rhinos, zebras and antelopes roaming around. They would even walk up to the car to look us over. Of course up went the windows when they approached!

The Kansas City boys arrived a few days after I did, Lee WØAIW stayed with Robbie, and the others (Mike WØMAF, and Mac WØUQV) stayed at a downtown hotel. Now, these fellows really came prepared for a DXpedition with nearly a ton of radio equipment, power plant, antennas, spare parts etc. My equipment that was supposed to have been air freighted to me from Milan by I1AB some 20 days before my arrival had never arrived, so I was lucky that Lee and the boys had brought plenty of gear with them.

After spending a few days in Nairobi checking over everything and doing a little sightseeing it was time to depart for Mombassa. Away we went down to the railway station with all that radio gear. Lee and Mike shared one compartment and Mac and I the other. Those compartments were crammed to the brim with boxes, and I for one could understand why the ticket clerk said we had by far too much luggage to be taken "free." We could hardly move around in our compartments.

Upon arriving in Mombassa, we checked into a hotel. Mombassa is right smack on the seacoast so you get the benefit of all the loss of altitude by the temperature rise. If you want to sleep when you are in Mombassa, you get an air-conditioned hotel room or you

suffer. Mombassa is a typical seaport city, with all the big warehouses and docks. You see people there from all parts of the world. You see Arabian ships from Aden, Saudi Arabia, Muscat and the Persian Gulf ports. There are many Indian bazaar type of shops that sell everything under the sun. Then there are the native open air markets all over the town, selling many different things; carvings, bamboo products, carved ivory objects. There is meat hanging up on hooks covered with flies, dried fish, fresh fish—boy what a smell!

We were to board our ship for the Seychelles the next day. After lunch we all went up to our rooms and took a short nap in the nice cool air from the air-conditioner. After the nap, Mike decided to take a walk. He was back in about an hour and I asked him what he saw of interest while out looking around. He told me about seeing all those pretty wood carvings the natives were selling. This interested me and I went out to take a look-see myself. Every place I slowed down, they jumped me trying to sell me something. At one place they started showing me their wares and just for the heck of it I started haggling over the prices. They would offer me something for, let's say 30 shillings, then I would say I will give you 3 shillings, then they would say how about 20 shillings. I would say, 5 is my top price, and then they would say they cannot sell for less than 15 shillings as that was the cost price. I would then say my top price is 7 shillings. They would say that they were going to lose money but I could have it for 12 shillings. I would say no, no, no. Here's 10 shillings. I would have the money in my hand while saying this and if they hesitated I would start walking off. They would let me walk about 25 feet, then would say OK, we will sell it to you, then would wrap up the item in a piece of newspaper and hand it to me. Well, those carvings were beautiful, the prices were cheap (after haggling for a while), and I ended up with a good sized box of carvings before I got back to the hotel. I had spent a total of about $10.00.

When I arrived back at the hotel with the box full of carvings, I dumped them on my bed, and when Mike saw them he asked me how much they cost. When I told him $10 he said, "Gus, when we get back from the Seychelles, I want you to buy me a whole big batch of them at the same price you paid for these." That little story will be told later on.

We got up early the next morning and away to the docks and boarding the ship—The Kampala—a nice sized boat and spotless. After everything was placed in our cabin, we strolled around the boat and after a short while anchor was lifted, the big 77 cycle whistle was tooted, and away we were!

Now remember this was the very first time in my entire life that I had ever been on a boat, except one little row boat in the Edisto River near Orangeburg, S.C., and the little 10 foot sail boat I used to sail around Lake Fairview when I lived down in Florida many years ago. To me every minute of the trip to the Seychelles was real adventure. Once or twice I felt the first signs of a little butterfly in my stomach—then I would say to myself, "Look here, Gus, you just can't be seasick, you are here for a DXpedition. This is the one and only trip to the Seychelles you will ever have, you cannot afford to get sick now." Then I suppose I would talk myself out of getting seasick. This system has always seemed to work for me.

After the ship was at sea, out of sight of land, we decided to see what the chances of a little /MM was. The ship was pretty fair sized, about long enough for a full wave 160 meter antenna and broad enough for at least a ½ wave 160 meter antenna. I knew that the antennas they used for their wireless would certainly be long enough for us to use. Lee had made this trip to the Seychelles before and had become acquainted with the wireless operator and had approached him previously regarding some /MM work. Up we went to the wireless room and after drinking a cup of tea and some talk it was decided that /MM was all OK. We brought up our gear, had to make up a makeshift antenna tuner to match the long wire antenna they had on the ship—good old Lee had brought along a little junk box full of condensers, coils etc. We were on the air as WØAIW/MM. All the world seemed to be QRX for us and we had a ball all the way over to the Seychelles operating /MM. I remember I was at the key when the Seychelles were first sighted—about 5 am—and I gave the boys a running account of its appearance to me. When you first see the island, Mahé, all you see is a mountain top sticking out of the sea, with a few hazy clouds floating above it. I guess a good description of Mahé is to just say it's a ridge of mountains about 35 miles long that sprung up out of the sea ages ago with beaches on each side of it. People live all over the island but it's more thickly settled around Port Victoria, the only port in the island. There are a number of much smaller islands around Mahé. The ship could not pull up to the docks on account of the shallow water so it anchored out in the bay about

one mile from the landing docks and many of the small island boats met the ship. One of these took us ashore. I landed and walked right into their customs. They asked, "Do you have anything to declare," and I said, "No." They thanked me and I was at the Seychelles—VQ9 land.

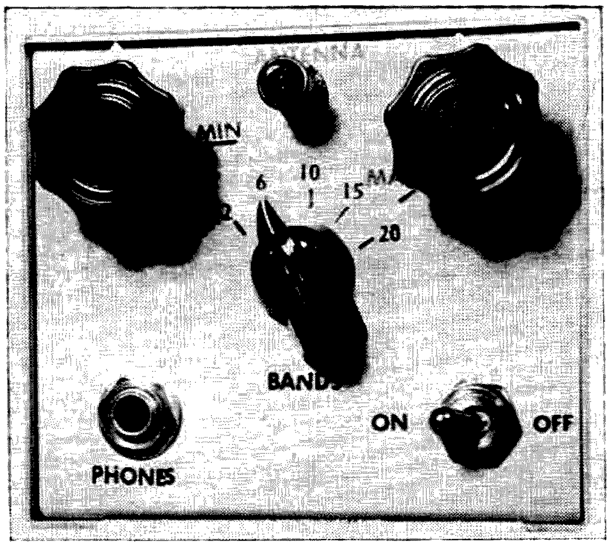
When you land at the Seychelles you notice that there seems to be lots more females on the island than there are males. Someone told me the population is something like 7 to 1, or maybe it's 9 to 1. Now this does make life there a little bit more interesting. Young men who are tired of a drab unromantic life in the USA (or any other country), you go to the Seychelles. I was once telling ole Bill W7PHO about things there and he said if he ever went there he would take a 5 gallon bottle of Geritol with him! Well, I told him that sounded like a very good idea. In case any of you are interested (as near as I can remember, at least) it costs about $80.00 for a one way trip, by boat from Mombassa, Kenya to the YL's—I mean Seychelles. But make your reservations early because there are a lot of VU2's going on a one way trip from Africa, so the boat is usually sold out well in advance. My second trip there I had to fly to Bombay and go there by the long path, because of this "hold out" business. There is a ship about once every month from Mombassa and from Bombay. Hotel rates are FB, it cost me $22.00 per week, room and board and any other service I wanted. More about this when I come to my second trip there a few years later.

We were met at the docks by Anton Schwartz who runs a small exclusive sort of hotel on the island; he had his station wagon and we loaded everything up. We met Harvey Brain VQ9HB and gave his boat the once over—and Mike said "OH No" when he saw the boat, I said, "Well it looks good to me!" I don't remember if Mac and Lee had anything to say—but I could see they were thinking!

Upon arriving at Tony's place, the first thing was up with the antenna—a vertical in the very top of an 80 foot coconut tree. I cannot say that conditions were good or bad during our stay there, I suppose they were just average. I do know that four people are too many to operate ONE transmitter. My rig never had arrived from Milan, so we were stuck with ONE rig and had to make the best out of it.

Next Issue—away for Aleglea Island, Who got sea-sick, and lots more!

. . . Gus



Howard Pyle W7OE
3434-74th Ave., S.E.
Mercer Island, Wash.

Two through Twenty FSM

Have you noticed how few of the many magazine construction articles and handbook descriptions of field-strength meters have pretty much side-stepped the higher frequency amateur band applications of this most desirable station accessory? I have for I recently had occasion to turn out a piece of gear like this and I pretty thoroughly searched available sources for suitable data, which was sadly lacking. I finally ran across a catalog page from Shurite Meters of New Haven, Conn., which seemed to present the basic answers.

These people, not too long ago commenced production of a 0-1 DC milliammeter modified especially for field strength applications and is known as their stock number 8903Z field strength meter selling for $3.95. While adaptable of course to use in any frequency band with appropriate circuitry, apparently they realized the lack of construction information covering the higher frequency applications. Accordingly they designed a circuit around this meter with emphasis on VHF usage . . . 2 through 20 meters. This was just what I wanted so I procured the meter and went to work using their recommended circuit and constants. It turned out beautifully and performs splendidly. Probably by using a couple more coils and two additional positions on the band switch, just as satisfactory results could be carried right on through the 40 and 80 meter bands as well.

I used a small LMB aluminum meter cabinet with a hole for a 2" meter; any equivalent cabinet can of course be used. With a small enclosure such as this (4"x4") the meter occupies the face of the cabinet and all controls are on the rear. Using a somewhat larger housing both the meter and the control knobs can be placed on a front panel if you prefer.

Rather than wind up the three coils I found that the J. W. Miller Company RF chokes with minor modifications were admirably suited for a compact job. One each of their catalog numbers 4606, 4588 and 4580 were required to cover the three frequency spreads from 2 through 20 meters. The #4606 coil should have five turns carefully removed, to cover the 10-20 meter bands; remove three turns from #4588 for six meters and two turns

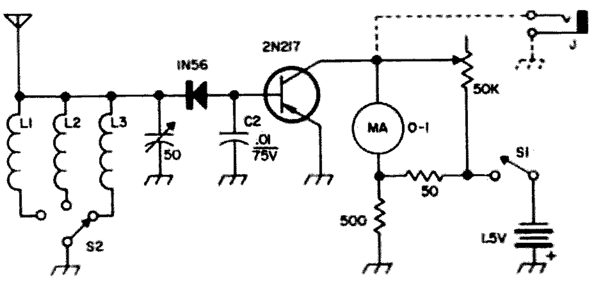
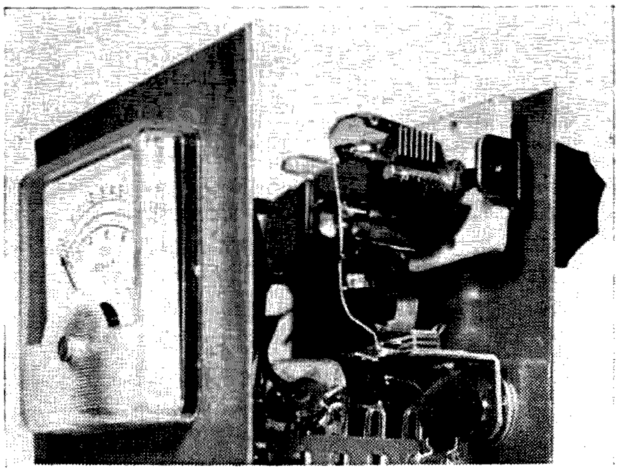


Fig. 1. The bandswitching, transistorized field strength meter for two through twenty meters.



Side view of the FSM.

from the #4580 coil to handle 2 meters. These can all be resonated with a 50 pf midget variable tuning capacitor; a Hammarlund HF-50 or the equivalent is excellent. Any of the small multi-point selector switches can be used for band switching. A JBT lever switch type SS-14-ILS will handle the job or, if you prefer a rotary switch you can use a Mallory type 3215J as I did, leaving two positions unused. (I might want to add a couple of coils and try 40 and 80 later!).

Resistors R-1 and R-2 shown in the schematic, need be only ½ watt. A single flashlight cell will serve for the battery although I chose a 1.4 volt mercury transistor battery to conserve space. Other items shown on the schematic are obvious and all parts are readily available from most electronic parts distributors as well as from the electronic mail order houses.

Build this little F/S meter and know what your VHF outputs are doing. If you want to check your modulation quality, a phone jack may be added as shown, making this little gadget really versatile.

. . . W7OE

Jim Kyle K5JKX

Improve Your Scope

Shielded leads should always be used with an oscilloscope when you're checking high-impedance circuits, since the unshielded variety can easily pick up 60-cycle ac fields which exist in every building wired for power. Yet most inexpensive scopes have no convenient method for attaching shielded leads and maintaining the shielding intact all the way up to the scope itself.

Several writers have suggested replacing the original vertical-input terminals with some type of coax connector or fitting to remedy the situation, but most of these approaches have involved reaming out the connector hole on the front panel or other changes which hurt both the appearance and resale value of the instrument. In addition, most common coax fittings are a bit cumbersome to connect or disconnect.

On the writer's Heath Model OL-11, the problem was solved simply and quickly by the use of a length of Rg-58-A, a UG-88/U BNC fitting on the end of the coax, and a UG-657/U BNC pressurized receptacle at the scope. The UG-657/U is the unusual part of this modification. It mounts in exactly the same hole left when the 5-way connector provided by Heath is removed, with no reaming, drilling, or other troubles.

Since the BNC is a spring-loaded bayonet type fitting, it is actually quicker to connect or disconnect than even conventional test leads. For this reason it is used in much laboratory-type equipment. Appearance of the scope is improved, if anything. Take a look at the photo and judge for yourself.

And if you're thinking, "Gee, that's nice, but it sure must cost," then stop worrying. The 1964 Newark catalog lists the UG-88/U cable fitting at 87¢, and the UG-657/U at $1.30. Thus for just over $2 you can have all the convenience of a lab-type instrument!

P. S.—It works just as well with VTVM's, etc. All the gear here is being converted over to this system, to minimize the number of test leads hanging around the bench!

. . . K5JKX

Ralph Hanna W8QUR

Varactors

A dandy device that came into being with other solid state items is the varactor. This is just what the name implies—a variable capacitor. They are variable by putting a negative voltage on them. Capacitance range is from a few pica farads to several hundred. The present units have the same size and appearance as any other diode such as the 1N295. They are finding very wide use in many applications such as: Remote tuned radio receiver, remote tuned VFO, automatic frequency control in FM receivers, frequency modulators, audio frequency amplifiers, a parametric R-F amplifier at microwave frequencies and as frequency multipliers.

The first practical voltage variable capacitors were two plate devices with a high dielectric layer such as barium titanate. These units would not handle much power, were quite critical to temperature change, and would tend to fatigue when cycled, as with a sweep circuit. These disadvantages slowed the use of this type and tended to discourage use of them even as they became very reliable as they are today.

The modern voltage variable capacitor is a specially processed, tiny P-N junction diode and looks like one. The life is infinite and most of the previous disadvantages have been overcome. The price is quite reasonable. These newer units go under a variety of names depending on the manufacturer. Raytheon has the Varactor, RCA and Bendix also use Varactor, while Crystalonics uses Varactron and Pacific calls them Varicaps.

Hughes has done about as much as anyone and has a line of high "Q" units that range in price from $1.80 to $3.80. Of course, like other semi-conductors, you could pay well over $100 for one.

If you are interested in seeing circuits of actual production items, take a look at the Collins 75S3 receiver where one is used with a potentiometer to control the variable BFO and rock steady it is. Motorola and Heath both use one in the automatic frequency control circuit of their FM sets, and eliminate one tube and the associated circuitry.

. . . W8QUR

Ronald L. Ives

Success with Decals

Decal labels are standard on much commercial, and some amateur, radio equipment. Decals to fill almost any imaginable need are now available from several manufacturers. Application of decals is relatively simple, and results should be good if the manufacturer's instructions are followed carefully. Unhappily, this is not always the case. Trouble is frequently experienced with decals that won't stick, that crinkle, or that peel off a few weeks after application.

Refusal of decals to stick properly to the panel is usually caused by greasiness of the surface. This trouble is most serious with crackle and similar finishes, in which the depressions in the coating collect oil or grease. Water will not wet a greasy surface, so the decal will not stick to it.

Surface grease can be removed from panels easily by use of either carbon tetrachloride or benzene (lighter fluid). Apply this with a cotton swab, rubbing the surface gently at the time. Let it dry before applying the decal. Be sure that the workroom is adequately ventilated—benzene is mildly toxic, carbon tetrachloride is very toxic. Where the panel greasiness is extreme, flood with the solvent, and remove the excess (in which the grease is dissolved) with a blotter.

Decal adhesion is also expedited if the water in which the decal is soaked to loosen the paper backing contains a trace of alcohol, a few drops of almost any detergent, or even a trace of soap.

After the decal is in the desired location on the panel, initial drying can be speeded by removing excess water with a lintless blotter (photographic white blotter is ideal). In damp environments only, final drying can be speeded by use of a hair dryer, at low heat. Do not use a heat gun, as this may crinkle the decal hopelessly, or even blister the panel finish.

Decals are commonly bonded to the panel by dissolving the transparent backing. This is commonly done with lacquer thinner, although one manufacturer (Tekni-Cals) supplies a special solvent for the purpose. As lacquer thinners vary considerably in their properties, this is a step in the right direction. In place of lacquer thinner, a less active solvent is recommended. Rubber cement thinner works very well here, and is both less volatile and less toxic than most lacquer thinners. With this relatively gentle solvent, dry decals will not tend to crinkle, and the panel finish is not likely to be stained or damaged. This same rubber cement thinner is also a good degreaser for panel surfaces. Although flammable (do not spill it on the soldering iron), its fumes are not violently toxic, so that you can use it all day, with reasonably good ventilation, without getting a splitting headache.

Tendency of decals to wear away after a time can be reduced by giving them a protective coating of clear lacquer. Let the decal dry in place for a reasonable time, such as 24 hours, then give it a thin coat of clear Krylon, or a thin coat of clear fingernail polish (such as colorless Cutex). Let this dry hard before handling. This protective coat can be renewed periodically if necessary.

. . . Ives

Fred Blechman K6UGT

The Proxy Patch

"CQ, CQ, CQ Miami, Florida, or vicinity. K6UGT, King Six Ugly Grumpy and Tired, Canoga Park, California, looking for any station within a hundred miles of Miami, Florida. K6UGT tuning for a call. Come in Florida!"

"K6UGT, K6UGT, K6UGT. This is WA4-FVD, in Marathon, Florida. Can I help you? K6UGT, WA4FVD standing by."

"WA4FVD, K6UGT. Thanks for the call. You're booming into Southern California this morning. Handle here is Fred, running a DX-40, plate modulated. How far is Marathon from Miami? I'd like to make a phone call to my mother in Hallandale, just north of Miami. WA4FVD, K6UGT. Go ahead."

"K6UGT, this is WA4FVD. You're 20 over 9, Fred. Handle here is Ron. Golly, I'm pretty far south of Miami—about 100 miles. Can I make a collect call for you? Break."

"Yes, Ron, please do. Only I don't want to run up my mother's phone bill, so let's make this a 'proxy-patch'. Do you know what I mean, Ron? Break."

"Proxy-patch? Never heard of it. You mean phone patch? Go ahead."

"No, Ron. A proxy-patch is something most guys don't realize is available. It's not a piece of equipment—it's a method. This situation is a perfect example. You are able and willing

to make the collect call, but I don't want the charges put on their bill; however, I'm perfectly willing to have the charges put on *my* phone bill! So do this, Ron. Dial 'Operator' and tell her you want to call Miami collect, but you want it charged to a California telephone number. My mother's name is Dee, her number is 305-923-5774; my number, to which all charges should be billed, is 212-346-7024 in Canoga Park, California. The operator will probably call me here to verify that I'll accept the charges. Got that, Ron? WA4FVD, K6UGT standing by."

"K6UGT, WA4FVD. Wow, Fred, that sounds wild. It's a new one on me. Let's give it a try. Hang on while I dial the Operator . . ."

Well, dear reader, contact was made in less than a minute! I've tried this several times, and it doesn't shake up the operators at all. Apparently it is an accepted procedure, though unknown to most people. For cross-country amateur radio telephone calls it's just great! No longer do you have to hit the location you're seeking on the nose. If you're calling a friend and don't want him stuck with the collect charges from a nearby (but not local) ham, have the station place the call through the operator and charge it to *your* phone. Similarly, if you hear a station calling an area toll-distance from you, suggest that you place a proxy-patch collect call charged to *his* phone. The toll charges, of course, are computed only between the parties actually on the phone. Don't get worried if the charge acceptance isn't made at the time of the call—if the lines are busy, the operator will verify sometime later.

Proxy-patching should increase the use of selective, purposeful calls on the ham bands . . . and will also make the phone companies a little richer from the tolls on calls that might not otherwise be placed!

. . . K6UGT

Ronald Ives

Diode Center Taps

Some years before most of us were born, an unknown genius found that a single-ended coil could be made to drive a push pull circuit (rather inefficiently) by use of a resistive center tap, as in Fig. 1. Drive applied to the load (here shown as a tube grid) was slightly less than half of the full coil voltage if the load drew no current, and very much less than half of the coil voltage if current was drawn.

If our load is designed for class B operation, so that only one half cycle is used by each half of the load, the same single-ended coil can be center-tapped by means of a pair of diodes, as in Fig. 2, applying substantially the full coil voltage, during the pertinent half cycle, to the load. Because of the high conductance of modern diodes, current drawn by the load has little effect on the applied voltage, and the diode center tap does not act as a "Q killer", so that this method can be used with peaked and tuned circuits.

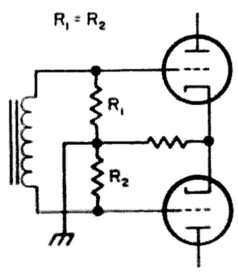


Fig. 1

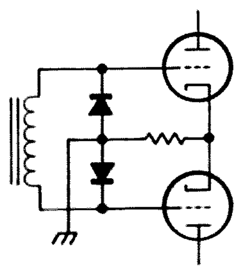


Fig. 2

This substantial immunity to current drain makes this type of center tap ideal for use with transistor circuits, as in Fig. 3. Here, also, the diode center tap prevents the negative half wave from putting too great a reverse bias on the base of the transistor, a "sticky" problem with some center-tapped transformers and some silicon transistors.

By replacing the conventional diodes with Zener diodes, the forward drive can be limited to the Zener rating of the diodes, as in Fig. 4, so that the transistor base is protected against over-volting in both directions.

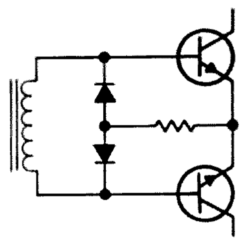


Fig. 3

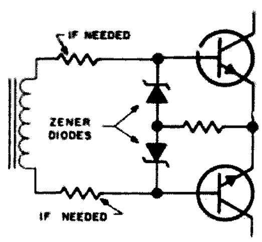


Fig. 4

All of these diode center taps seem to work as well in practice as they do on paper, and the Zener center tap (Fig. 4) has some very definite possibilities as a volume compressor, in addition to its merits as a transistor base protector.

. . . Ives

Harvey Pierce WØOPA

Added Utility for the HO-13

The Heathkit HO-13 Ham Scan panoramic adaptor is a very handy piece of equipment for the ham station, but it seemed a shame that such a nice 'scope should serve no useful purpose while transmitting. Examination of the circuit showed one of the vertical deflection plates was used only for positioning the trace. Not only that, but it was unbypassed, isolated by a 47K resistor! Why not feed some transmitter rf to this plate as was done in my Simplescope?

But the vertical trace sould have to be disabled, to avoid the stray receiver pickup interfering with the transmitter pattern. A further study of the diagram showed the most likely way to do this would be to open the cathode circuit of V4, the 6EW6 last *if* tube.

The adaptation to a transmitter monitor was easy and inexpensive. Two phono jacks were added to the rear panel and labeled CONTROL and ANTENNA. At the socket of V4 the 68 ohm cathode resistor (R41) and the .01 mf capacitor (C40) were ungrounded and their ground leads separated. The capacitor was regrounded and the resistor lead was connected to the control jack by a length of shielded wire. Things are crowded around V4, be careful to avoid shorts.

One lead of a 100 pf ceramic capcitor was soldered to pin 9 of the 3RP1 CRT socket (the one with the 47K resistor connected to it). The other lead was run through the grommet with the other wires and connected to the antenna jack.

A cord and phono plug connect the control jack with a set of relay contacts that are normally closed when receiving and open when transmitting. A shorted plug can be provided for this jack to restore the Ham Scan to normal operation. Any antenna, probe, or rf pickup that will produce a ¾ inch wide pattern of transmitter rf can be plugged into the antenna jack.

The sweep frequency of the Ham Scan is so low that the audio frequency waves are too crowded for really accurate analysis, but modulation percentage, hum, noise, and feedback are easily seen. The band scanner action is unchanged. While this adaption is for am primarily, it will also give useful wave-shape information for ssb and even cw.

If you did too good a job, per original directions, of wiring R41 and C40 together, it might be easier to replace them than separate them. Also, mounting the phono jacks on the rear panel is easier if the astigmatism control is unfastened and moved aside temporarily.

Why not make your HO-13 do double duty? It isn't hard to have a transmitter monitor too.

. . . WØOPA

Stanley Zuchora W8QKU

Pauper's Portable Power Pack

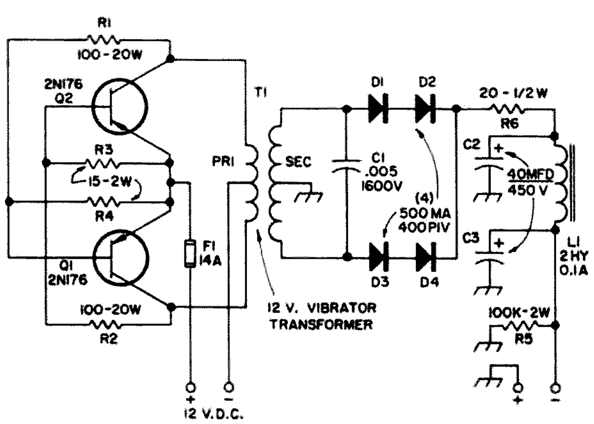


Fig. 1. Schematic of the Pauper's Portable Power Pack.

I suppose that we've all needed a small mobile power supply at some time or another. I decided to build one and checked prices. Ouch. The special power transformers and power transistors looked a bit too steep for me, so I reluctantly decided to by-pass the project for a while. Then I had an idea and started experimenting. The result was this simple project that uses a discarded 12 volt vibrator transformer from an old car radio and some cheap transistors from Poly-Paks (two for a dollar.) Other PNP transistors that have been used with good results are the 2N234A, 2N256, 2N441, 2N442 and many others. Since the supply is low power, there is no need for a fancy heat sink. Just mount the transistors on the case about three inches apart and use insulating kits or mica washers under them. The transistors switch (oscillate) at about 100 to 120 cycles, perfect for this type of supply. Don't overload the transistors. I've built a number of these supplies and they've all been useful and have stood up well.

. . . W8QKU

George Hunt W4NUT

The Super HX 20

After some revamping of the Heath HX-20, I have been able to get a full 115 watts of rf into the antenna. For those of you interested here is the easy conversion.

Parts Needed

1 blower, Burstine-Applebee catalog number 4A83	$ 6.99
1 ceramic loctal socket from "TAB" N.Y.C.	.50
1 Octal male plug	.70
2-200 ohm 2 watt resistors, carbon	.36
14 inches #18 plastic covered wire	
1 .01 mfd discap small	.15
1 .001 mfd discap small	.15
1 4X150 or 4CX250 Surplus Bill Slep Co	8.00
	$16.85

Assuming you have the HX-20 built and working, before removing from the cabinet, carefully determine the center of the 6146, this is from the top, and is best done with a toothpick carefully inserted through the vent holes, mark the center thus found on the top of the cabinet. This will be the blower position and is the only alteration to the cabinet of the HX-20. Remove unit from case, remove the 6146 and plate cap. Turn HX-20 over and find resistor R75 (100 ohm ½ watt) remove and replace with the two 200 ohm 2 watters (parallel for 100 ohms 4 watts). Lift wire at junction of R81 and R82, string a new piece of #18 plastic covered connecting pin 5 of PL (unused pin on male power plug back of unit) and the other end connect to the wire end lifted from junction R81, 82. This will be your final screen supply from external power supply. Now, by using the male octal plug and the ceramic loctal socket, and by wiring these together an adapter for 4X150 to 6146 will be made. By following these steps you will come up with a bug free unit. You will note built in rf eliminators. Keep the leads short and direct. Connect as follows.

Loctal Socket Pin.	connect to	Octal Plug (male) Pin.
1		3
2		2
3		2
4		4
6		6
7		7
8		1
Center		5
1 .01 mfd		1
7 .001 mfd		6

By compressing this assembly down to 1¼" overall height (base to top excluding pins) and then filling with "epoxy" putty and shaping, and holding the 1¼ inch height, when the 4X150 is added, the added overall height equals the height of a 6146 this is important. At the point marked on the outside cabinet cut a 1¼ inch hole and mount the blower. If your center is right the blower will be directly over and within ½ inch of the 4X150 radiators. Slip a 4-40 × 1¼" bolt through the radiator, use a solder lug on the top and a nut on the bottom to hold in place, this will be the plate connection. Solder the plate lead to lug after 4X150 and adapter are in place. Insulate the partition nearest the tube; plain insulating tape will do. This will prevent accidental grounding of tube. Assemble and put back into cabinet. The power supply should be able to furnish 1000-1200 volts at 250 ma, 300 volts regulated to pin 5 of P1, screen supply, 110 ac for blower and you are ready to tune exactly as you did for the 6146. You will be able to load to 240 ma and get 115 watts out with approximately 250 watts in.

To go back to mobile operation just remove 4X150, insert 6146 and operate with your mobile power supply. Do not use the 4X150 without the blower. Worried about that hole? Don't. A new case can be bought from Heath for about $4.50. Or you can use a snap in plug to fill it in.

. . . W4NUT

Murray Baird W6LWE
1231 Tenth St.,
Manhattan Beach, Calif.

The Full Wave Tripler Myth

Recently the need arose for a good husky voltage tripler power supply—one that would deliver power to a pair of television sweep tubes operating as a linear amplifier. In reviewing the learned writings of the various authorities the article in June 1961 issue of "73" came under scrutiny. Gad, how I would like that day to live over! Included in the article was a "Full Wave Tripler" circuit claiming all sorts of advantages over the conventional half-wave lashup. For those miserable souls who had their Sept. 1961 issue thrown out with that stock of newspapers lying around the house, the circuit is reproduced in Fig. 1. If you're smart you will immediately clip it out and throw it away. It's as phony as the proverbial four-foot yardstick.

To get back to the sad story, I pondered the glib explanation of how the thing worked both as a bridge rectifier and a full-wave doubler, the voltages thus produced adding to supply triple output. It seemed the perfect answer, so ignoring the small voice of common sense, it was breadboarded and fired up. Instead of the expected 450 volts, a disappointing 300 volts appeared. Check the circuit, the diodes, the capacitors, still only 300 volts. One whole evening wasted monkeying with the thing, plus half the night pondering the unhappy situation. I re-read the blasted article a half dozen times on the assumption that old "never-say-die" Green must have slipped it in as a joke. But no, he sounds serious and you get the idea that it's really supposed to work.

The next step was a fast letter to the editor. The not-so-fast reply was to the effect that there was no mistake—it was supposed to triple—and out of umpteen thousand readers I was the only one with the temerity to question the authenticity of it all.

More pondering. It looked as though I was worse off than at the beginning. I still needed a good husky voltage tripler and now I had to prove that 73 Magazine had slipped its trolley for once. After dissecting their ill-begotten circuit to see what actually happens during each half-cycle of input voltage it came out looking like Fig. 2.

In Fig. 2A input terminal 1 is positive, terminal 2 is negative. The current path is through diode D1, through capacitor CI, and finally through the 5 ohm resistor to the positive terminal. The current charges CI to about 150 volts. Notice that no current flows through diode D4 since no potential difference exists across it. In other words, capacitor C2 is not charged during this half-cycle, only CI.

On the alternate half-cycle things are reversed. Current flows through C2 and D2, while D3 sits idly by. C2 charges to about 150 volts and the D-C output is the addition

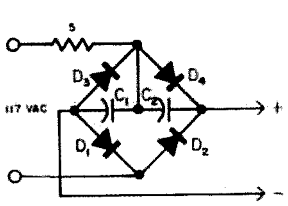


Fig. 1. "Full Wave Tripler." It doesn't work.

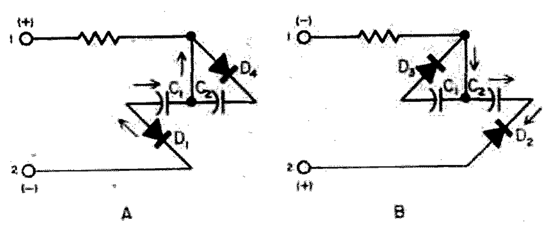
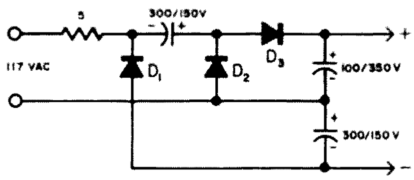


Fig. 2. What happens in the circuit of Fig. 1.



ALL DIODES 750MA/400PIV

Fig. 3. Good tripler circuit.

of the charges on C1 and C2, around 300 volts. Removing D3 and D4 from the circuit neither helps or hurts matters; they were just sitting there doing nothing in the first place. So much for the full-wave tripler myth.

Actually the article was a good thing; it stimulated some thought on the subject. A couple of hours doodling produced the circuit in Fig. 3. If we are thinking in terms of full and half-wave triplers, I guess this one would be called a ¾ wave tripler. During one half cycle C1 and C3 charge; C2 charges during the alternate half cycle. It represents a substantial improvement over the conventional half-wave device. Since none of the capacitors are charged to the full output voltage, a higher capacity, lower voltage capacitor can be used, thus improving the regulation while still maintaining the same overall size. There is both 60 and 120 cycle ripple present in the output but they tend to cancel so that overall ripple voltage is substantially lower. In all fairness, it has the same drawback as all the full-wave types—both sides of the 117 volt a-c line are floating with respect to the rectified output.

With the values shown in figure 3, output voltage under load comes out as:

No load	520 volts
100 MA	490 volts
135 MA	480 volts
220 MA	460 volts

. . . W6LWE

John S. Campbell WA6RCY

How to Get "Tight"

During the construction of my latest linear amplifier attempt, I had occasion to require an electrically "tight" compartment that also was air "tight."

I was using a 4-400A with a tuned grid and did not have the wherewithall to purchase the fancy Eimac Air Socket, so I got a 5 pin septar socket and proceeded to utilize a separate chassis for the necessary aforementioned compartment. Although I had scrounged some finger stock from a piece of surplus, it didn't seal the pressure off.

Then I remembered that a while back, I had done some printed circuit work and had a bottle of *General Cement's* "Copper Print" kicking around the shack. The stuff comes in liquid form and is easily brushed on. It dries in about an hour to a highly conductive coating that will seal little cracks and openings, found in most manufactured chassis. By sealing these openings, the compartment is also physically sealed. (Don't forget to secure the compartment with screws, or rivets, the stuff isn't epoxy glue!)

With reasonable proximity of mating surfaces, a compartment may hold 25-40 psi (depending upon volume) and be electrically "tight," using the copper print. For VHF work, the silver print would be better, though quite a bit more expensive than the copper and it might not make any significant difference.

. . . WA6RCY

Ronald Lumachi WB2CQM

Systematic Antenna Tuning

Antenna tuning reduces itself to the adjustment of such variable factors as gamma match, director-reflector length and spacing. Each adjustment in a parasitic array not only affects the variable being adjusted, but as a consequence materially alters the reflected electrical characteristics of the companion units. Obviously a detailed schedule of adjustments should be adopted. To satisfy this need, and in order to relieve the burden of at least one variable, the tuning of the antenna should be accomplished using the radiating system in its receiving capacity. Consequently, it was assumed, although arguable, that an antenna tuned for maximum gain should provide the most efficient radiation. Employing this method eliminates constant transmitter retuning with each change in the antenna.

A typical arrangement for tuning would include the erection of an exciting dipole cut to the exact half-wave at a desired frequency. The half-wave antenna should be "fed" by a low power transmitter (10-50 watts) and placed as near the antenna as possible. This will insure that radiation will not be sampled from an overly long coupling line. The height of the exciting array should be placed a reasonable distance from ground potential and the parasitic array raised to a level horizontal with the exciting antenna. A spacing of at least two wavelengths should be maintained to prevent interaction from stray fields.

A VTVM of high input impedance should be coupled to the antenna through a short length of co-ax line. The meter can be strapped to the mast and relative changes viewed as adjustments are made. A high ohms-per-volt ratio unit is necessary and somewhat superior to a sensitive field intensity meter because of the minimum loading characteristics on the circuit being measured. The meter does not require any calibration since relative power maximum deflection is the norm.

With the antenna immersed in a fixed field of radiation, the driven element is the first variable adjusted. In the event a matching unit is employed, it can be simultaneously adjusted with the electrical length of the driven element for maximum meter deflection. Adjustment should then proceed to the director element nearest the driven element, again striving for maximum rf pickup. In the event the array has additional directors, altering should proceed outward from the reference (driven element) until the aggregate nets a maximum indication of induced voltage. Rotation of the array 180 degrees from the exciting source will allow reflector change for a minimum meter deflection. Additional fine-tuning will usually increase the relative sensitivity of the system.

Though this is not by any means the last word in scientific beam tuning, it will undoubtedly give you better results than you could possibly expect with a hastily erected beam tuned just by manufacturers measurements. Beams react to their environment and no two are placed in exactly the same circumstances, which means that you'll get improvement if you tune it up. Tune.

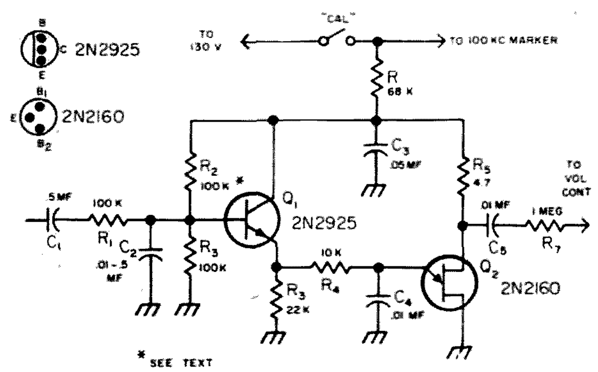
. . . WB2CQM

Tom Lamb K8ERV

The Zerobeater

Most modern receivers have a 100 kc standard. Most modern receivers have poor low-frequency response. Most modern ears are even worse. These make accurate zero beating nearly impossible. The Zerobeater comes to the rescue!

The Zerobeater is an audio oscillator whose pitch is varied by the sub-audible frequencies near zero beat. It's slowly wavering note is quite easy to hear and permits very accurate zeroing between any two frequencies you want to compare. It was designed for the Drake 2A, but should work with any receiver.



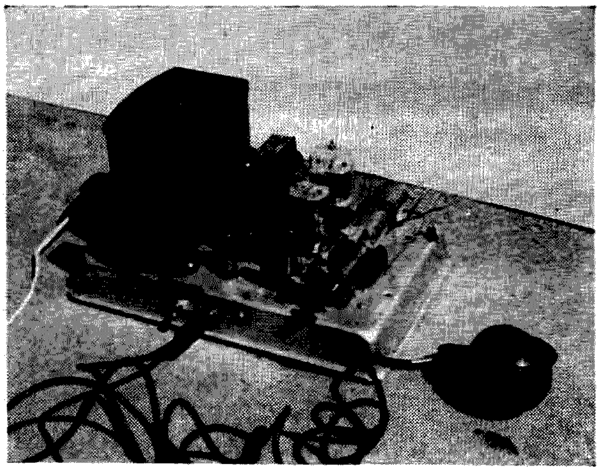
Q2 is a unijunction relaxation oscillator which generates a convenient "carrier" tone. The frequency depends on the voltage at the base of Q1. R2 is selected to give about a 1kc note with no input, and will vary with your particular 2N2160.

The input is connected to the plate of the product detector to pick up the sub-audible beat notes. These are coupled through C1 which is large enough to pass frequencies below 1 cps. C2 prevents pitch variation for beats above about 20 cycles for smoother operation, but can be reduced to a carrier filter of .01 for economy if desired.

The "Cal" switch is convenient to turn the device on in the Drake. To operate, turn on the calibrator, the product detector, the BFO, and the Zerobeater. Approach one of the check points. As your beat note becomes too low to hear, you will hear the Zerobeater pitch wavering, and can follow it to exact zero beat.

This precise beating system is quite a help when setting the marker or other frequencies against WWV, or when making accurate measurements with a 10kc marker.

. . . K8ERV



R. E. Baird W7CSD
3740 Summers Lane
Klamath Falls, Oregon

A Low Power Standby Transmitter

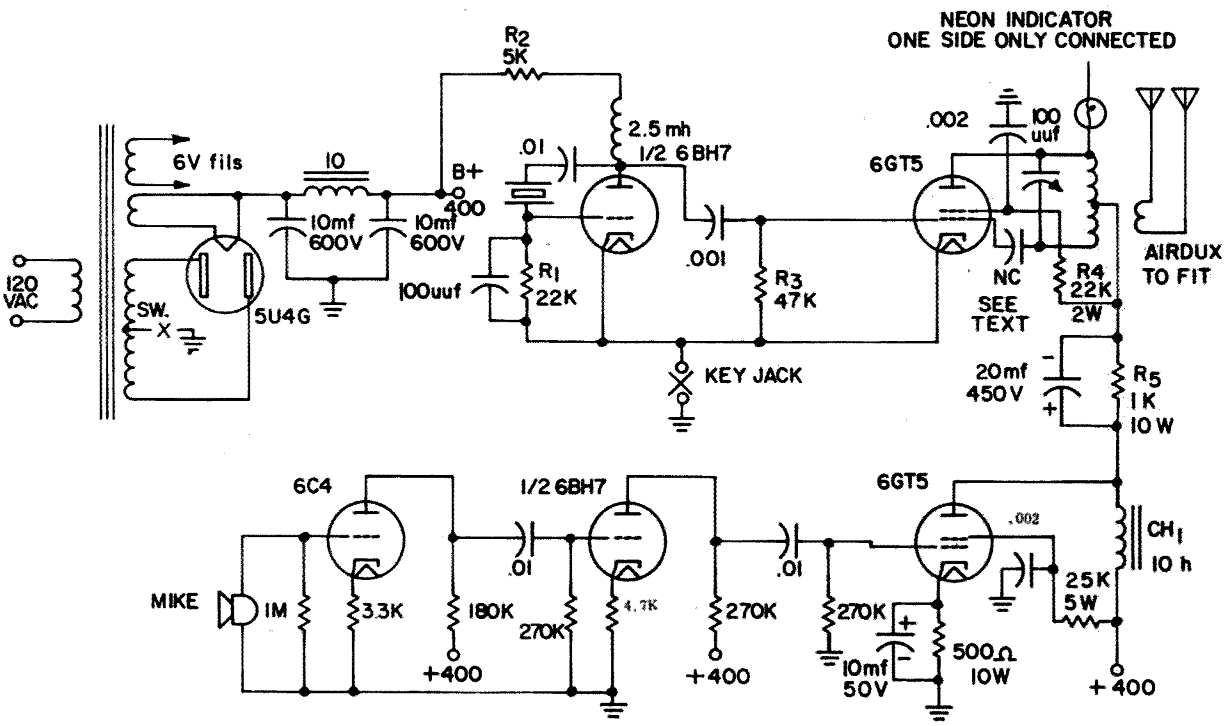
It's always nice to have a small rig that will go on the air at a moment's notice if the big rig conks out, or if you want to make major changes and still have something that will get on the air in the meantime.

We started out to see what the Novar 6GT5 would do, and evolved the following. The chassis is a 49c aluminum cake tin which we pretty well jamb packed. The power supply is a standard 400 vdc at about 200 ma built on one end. The on-off switch merely turns the "B" supply on and off ahead of the filter.

In order to conserve space and circuitry the oscillator is a Pierce which works equally well on both 40 and 80 meters (with the right crystal in the socket). It was found that by placing the 100 mmfd capacitor across R_1 the rf output of the oscillator is about doubled. This does not appear in any of the handbook Pierce oscillators. R_2 drops the plate voltage of the oscillator to between 250 and 300 volts.

The amplifier uses the Novar 6GT5 tube in a conventional circuit. The neutralizing capacitor, which by the way is necessary with this tube, is simply two pieces of plastic covered hook-up wire twisted together until neutralizing is proper (just a couple of twists). With a plate voltage of 300 volts the amplifier leads into a link coupled doublet antenna to about 65 or 70 ma.

The Heising modulator consists of a second 6GT5 operating at 400 volts and about 80 ma. This seems like too much for the rated plate dissipation, but no sign of color was observed.



It will modulate the rf amplifier right out to 100% on both peaks. The speech driver is the other half of the 6BH7 oscillator tube and the first stage is a 6C4. This arrangement with the mike used was just about right without any volume control. If a weaker mike were used, the cathode resistors on the first two stages of speech could be by-passed to bring the gain up. There is a key jack on the rear of the chassis for CW purposes. The modulator is left connected when on CW just to act as a load on the power supply when the key is up. Additional power could be obtained by installing a switch to short out the Heising resistor R_5 when on CW. This might be desirable if the transmitter is for novice use or if much CW operation is expected on the part of a General license holder.

Operation: Many hams would take a dim view of a 20 watt phone rig; however, if it is well modulated it will get out surprisingly well. From the W7CSD location we have worked everything from San Diego to Vancouver, B. C. in one afternoon on 40 meter phone with 100% QSOs for the most part. People don't understand how 20 watts can get out so well. It's mainly because they haven't tried.

. . . W7CSD

Paul Stecher

A Note on the 73¢ Noise Clipper

This efficient circuit, described on page 36 of the June 1962 issue of 73 Magazine, works best when feeding into a high impedance sound reproducer, such as crystal headphones. For this purpose it can be built right into the phone plug. Unlike the TNS or other noise limiters, it works on SSB, DSB, NFM or what have you, as well as on AM, since the clipping occurs in the audio stage and is not dependent upon AGC or carrier action.

As is, our audio clipper will not work effectively with a speaker because of the low impedance of the voice coil winding. If you want to use this clipper with a speaker, do not throw away the miniature autotransformer you find in the box of the surplus MC-385. Connect this impedance-matching transformer between clipper and speaker, and the clipping action becomes apparent at once. There is no noticeable insertion loss. If you do not have an MC-385, you can use to advantage the surplus headphone-impedance-matching transformer C-410 which is part of the CD-604 cord and plug assembly. If you do not know which way is the low impedance end of the transformer, measure the dc resistance at each pair of terminals, using an ohmmeter. The low ohm terminal pair goes to the speaker. For this particular type of transformer, the dc resistance multiplied by 1.5 gives the approximate impedance at 1,000 cycles.

I am using this clipper on my 75S3 with most gratifying results. The clipper is connected to the antivox terminals (a 500 ohm audio output) and the C-410 is connected between clipper and speaker. When connected in this manner, the speaker is not muted when the headphones are connected to the receiver through the regular phone jack. In this case no separate clipper is needed for the phones, since the noise limiting action is extended throughout the audio circuit of the receiver.

Try this useful device. What can you lose? A few cents and an hour of constructive building. We don't build enough anymore, and you know it. Besides, you will not interefer with the wiring and circuitry of your precious receiver. In a New York apartment house, this gadget far outperforms the Collins 136B-2 noise blanker. Using the TAB silicon diodes specified in the original article, I experienced no degeneration at the audio frequencies and no mushiness, as is the case when the TNS limiter is advanced to a similar clipping level where the big elevator sparks produce but a gentle plop.

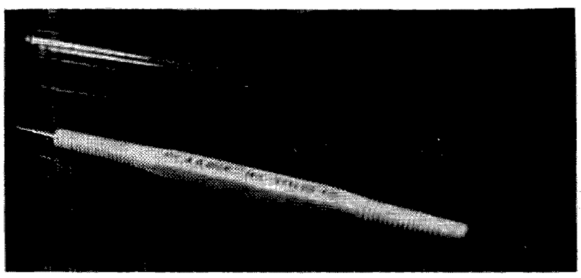
. . . Stecher

William C. Lewis WØCGO

Another Gimmick

Once you start to construct your own equipment it doesn't take long until you begin to collect a strange assortment of what you call your favorite tools. These are the gimmicks that are just right for that tough job in the far dark corner of that crowded chassis. The latest addition to my toolbox in this category is one which I borrowed from my secretary.

At this point the YL and XYL readers probably think that I'll admit to the use of a hairpin, but not a chance. The "tool" in question is a stylus commonly used for making diagrams on mimeograph stencils. I imagine that there are other manufacturers of these things, but the one I use is made by the A. B. Dick Co. #1411.



This stylus had a plastic shank and plated steel tips on either end. These tips are bent at a perfect angle for circuit work. One tip is larger than the other which is a handy feature when space is a problem. Magnetizing the tips will allow you to carry small items of hardware into far corners of a crowded chassis and the plating keeps the tip from becoming an integral part of a soldered connection.

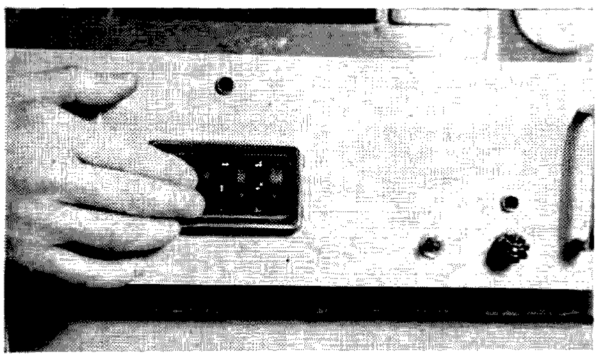
There are a variety of tip configurations available in this type of stylus, some more practical for electronic work than others. Although this aid is a little more expensive than the average soldering aid, the discriminating amateur who builds his own gear will find it a finer and more versatile tool than the average soldering aid.

. . . WØCGQ

"Tut" Tuttle WA6LUM

Metering with Braille

Blindness has not been an obstacle in the electronic career of Buddy Alvernaz W6DMN-AF6DMN. Buddy, an active Ham for many years, is continually "improving the breed". His interests range through the RTTY, FM, VHF and Hi-fi Audio. He has several patents to his credit. One of the main stumbling blocks to the totally blind technician is the problem of accurately reading meters. As a professional musician, Buddy has an extremely well developed sense of pitch, and for some years has used a transistorized audio tone comparison type meter with good accuracy.



Recently, with the assistance of Paul Barton W6JAT-AF6JAT, Buddy has developed a Braille meter that he is using with great success. This meter, a Hycon 615AR, was obtained through the Air Force Mars Program, in which AF6DMN has been active for several years. The instrument is a display type, involving motor driven drums. The conversion involved removing the glass bezel over the numerical display and applying appropriate Braille Symbols. The Braille Symbols were embossed on Dymo Tapewriter tape, using a Braille Writing Machine, and they stand out beautifully on the plastic tape. They were carefully located to correspond exactly with the original numbers. As Buddy is extremely competent in Braille he has no difficulty in reading the meter with absolute accuracy, and it is in constant use.

. . . WA6LUM

Ralph Hanna W8QUR

Pi Networks

The pi network has derived its name from its appearance in a schematic diagram which is quite similar to the symbol for pi that is used in mathematic computation relating to the circle and sphere.

This network is a very versatile thing, being used for high pass filters, low pass filters, antenna couplers, output circuits on transmitters and input from other stages in both transmitters and receivers.

One of the most common pi sections is one that many of us do not recognize as a low pass filter. This is the condenser input, choke and condenser that is used in most power supplies. In this case, the low frequency we want to pass is the pure DC and the unwanted portion is the 60 cycle and 120 cycle ripple.

The high pass filter used on TV sets is a multisection pi filter and so is the low pass filter used in the antenna lead of a transmitter to eliminate TVI. The difference between the two is that one has condensers in the run and coils in the legs. The other one is just the opposite. How can you remember which one is high pass or which one is low pass? In the previous paragraph the power supply was cited as an example of a low pass filter. This is one filter all of us know about and know that the condensers go from the high side to ground and the choke or resistor is in the run. Therefore, it is evident that the condensers are in the legs on a low pass filter and in the run on a high pass filter.

The most popular of all pi networks is the output circuit of a transmitter. This method has many advantages; the most important one is that the output of almost any transmitter can be matched to almost any antenna. This does not mean that because there is a good match that you will get out real good; it goes without saying that a resonant antenna is the very best. Another advantage is the reduction of harmonics, but don't let this give you a feeling of false security because the point of maximum harmonic suppression is not always the point of maximum loading. If in doubt always tune a bit to the higher capacity side of the point of maximum output. Tune the receiver to a harmonic and watch the "S" meter as you tune.

The big disadvantage of this system is the low efficiency. It is not possible to run more than 50% efficiency and it tends to be more like 30%. Other methods of feeding the antenna will result in efficiencies of as high as 65% to 70%. . . . W8QUR

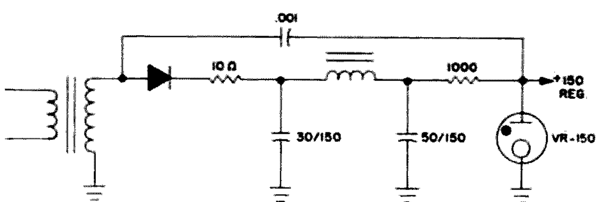
Jim Kyle K5JKX

Keeping a VR Tube Lit

The ordinary half-wave rectifier circuit, operating from either a TV booster transformer or a reversed filament transformer, is one of the most popular ways of providing approximately 150 volts for powering small station accessories.

However, such a simple supply offers some problems when you want to regulate the supply with a VR tube, because the supply itself often provides very little more than 150 volts, and can't keep a VR-150 lit under any sort of load at all.

One additional 15-cent component, though, will solve the problem neatly. It's a low-value capacitor (anything from .001 to .01 mfd, depending on what's available) from the top of the VR tube to the hot side of the transformer.



The capacitor couples the ac from the transformer directly to the tube, but the low value of the capacitor keeps ac current flow low. On peaks, the instantaneous ac voltage exceeds 160 volts, which is plenty to keep the tube lit. At the same time, the VR tube itself has such a low impedance to ac that no hum or ripple appears across the output.

Thus the instantaneous voltage across the VR tube can rise to 160 every 1/60 of a second, so if the tube goes out due to too much voltage drop in its dropping resistor it will be relit 1/60 of a second later—or as soon as the overload is removed.

This trick has been used to regulate a 155-volt supply to 150, dropping only 5 volts in the regulating resistor, with no ill effects. . . . K5JKX

Clean That Bug

To keep that bug or straight key in good working shape, its keying contacts should be kept clean. Relay cleaning tape, type K. S. 6528 is available from Hope Webbing Co., Inc. New York, Providence. R. I. and Chicago, Ill. or can be gotten from electrical and electronics places that deal with relays and Teletype.

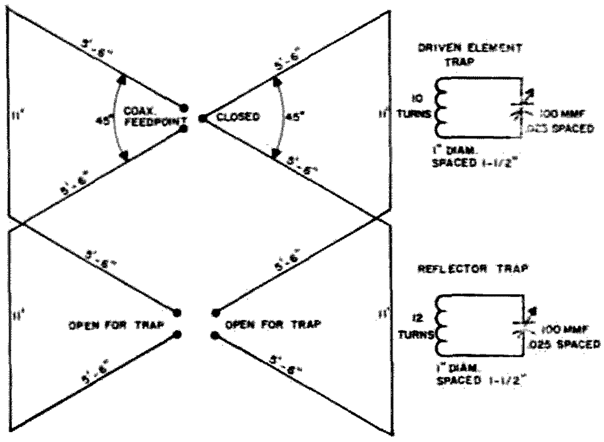
Every so often a clean tape is run between the keying contacts with the keying contacts closed once the tape is put between the contacts. Pulling on the tape will really clean those dirty contacts. Pull again with another clean tape if the first one gets dirty to make sure the contacts are good and clean. This takes about half a minute. A package of relay cleaning tape will last for years and of course the tape comes in handily for cleaning contacts on RTTY keyboards, TD's relays and so on. . . . K4GRY

Ben Bresler ZS3NZ
P.O. Box 486
Otjiwarongo, South West Africa

The Three-in-one Birdcage Beam Antenna

I have been building, testing, trying and what not most all kinds of antennas, simply because I firmly believe the antenna to be the most important piece of equipment in the whole amateur station. By doubling power to your final you will most probably raise a half "S" unit in another hams receiver. But by just making sure that your antenna is properly matched, cut to frequency, etc. you will undoubtedly raise up to three "S" units.

Now this article is not intended to cover antennas in general, but only one antenna.



ELECTRICAL CIRCUIT & MEASUREMENTS

How to get on three bands at low cost where space is restricted is what I would like to call OM Bird G4ZU's bird cage antenna. This antenna is by now well known to most hams so I will not go into the theory of the 10 db claim by OM Bird. I have not heard of the antenna being described as a tri-bander before so I hope this will be of some use to build it yourself ham fraternity.

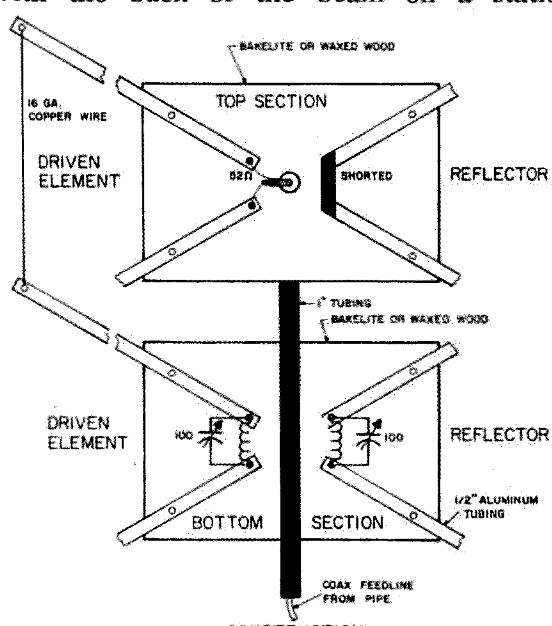
I started off by building the 15 metre bird cage described and like most fellows who have built bird cage antennas found that the measurements are too short. This did not stop me and I loaded the driven element and reflector with stubs. Reports on 15 meters was very, to say in the least, satisfactory. That was in 1962. This year the 15 metre band became a very dead band. So where to now? 20? Yes, 20 metres was decided on and the three in one antenna was born.

I did not want to take down the 15 m bird cage. I converted the bird cage so that it will be easy to go back to 15 metres any time.

The stubs were replaced with coils. Condensors (variable) were added across the coils. With the condensors placed at minimum capacity the coils were pruned to resonate the driven element at 21.200 mc. The reflector coil was cut for minimum signal off the back of the beam. This was done with the variable condensors in circuit at minimum capacity.

Tune through the 100 mmfd variable capacitor range on the driven element. Tune for maximum signal in the receiver at any frequency in the 14.00 to 14.350 range. Mark the condensor at the maximum signal.

Now tune the condensor on the reflector. With the back of the beam on a station,



CONSTRUCTION

tune for minimum signal. This will be found to be very sharp and slow tuning through the range is advised. With these settings for twenty the bird cage is also resonant on ten. Don't believe me? Take readings with a grid dipper.

It was not my aim to resonate the antenna on 10 metres, and I was quite surprised to find that it worked very well on ten compared to a four element 10 metre beam. As it is now you have a 20 & 10 metre beam. By running up the mast or switching arrangement the capacitors are nulled. And you are on 15 metres.

Reports have been very satisfactory on all three bands on phone with 40 watts input to the Tx final on AM & SSB.

It is advised that for higher power the coils and condensors are made larger to cope with the rf power.

The 52 ohm coax feedline is run through the pipe mast and is connected at the top of the antenna, so that all tuned circuits will be mounted at the bottom.

This antenna is well worth the low cost, time and space saving. The antenna is mounted on a ten foot tower placed on top of the roof (house).

. . . ZS3NZ

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION
(Act of October 23, 1962; Section 4369, Title 39, United States Code)
Publisher: File two copies of this form with your postmaster.

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I certify that the statements made by me above are correct and complete. (Signature of editor, publisher, business manager, or owner)

POD Form 3526

(Continued from page 4)

Buyer beware

A reader wrote in recently to complain that he had been badly stung by a 73 advertiser. I explained to him that I had cancelled the ads for this company a year and a half ago when they first started giving trouble. I try to keep in touch with what is happening and I think you'll find that 73 is by far the most careful of the companies it permits to advertise in its pages. With but few exceptions all of the reputable companies are advertising in 73.

DX-200 and DX-300

In this day and age when an active amateur can work one hundred countries in a few days and two hundred without severe effort, something more than DXCC is desirable. The Radio Club of Venezuela has come up with certificates for 200 and 300 countries. For full information on these certificates you might drop a letter to Comision De DX, P. O. Box 2285, Caracas, Venezuela.

Shucks, it only took me two weeks on twenty sideband with the little time I have available to knock off my first one hundred. I'm up to 150 now. If I could only get a bit more time for operating . . .

Contest?

While many of us are enjoying several of our bands, there are others who have settled rather permanently on just one band. I'd like to see some articles pointing up the joys of operating on our different bands written by experienced ops. Tell you what . . . we'll pay $50 each for articles that we accept for publication on "My Favorite Band."

ARRL Elections

Those of you who do not read the minutes of the yearly Directors meetings may not have much of an idea about which directors are interested in helping ham radio and which are there for the prestige of the office. Without going into excruciating detail, let me encapsulate it:

Moss and Spencer have shown time and time again that they are working for amateur radio. Indications are that HQ in Newington will leave no stone unturned to get these fellows out . . . they ask questions about those mysterious expenditures. On the other hand,

if you vote for Crossley, Cartwright, Engwicht or Denniston you deserve every thing that happens to you. Perhaps you like head-bobbing yes men?

Rotary award

ROAR, Rotarians of Amateur Radio, have a DX rag chewing award that might interest you. You have to have 100 international contacts, each lasting at least 15 minutes on phone or 30 minutes on CW, to get the award. For full info on this free award drop a line to W4RLS, Box 26, Russellville, Alabama 35653.

Still looking

We're still looking for an advertising salesman for 73. This is a difficult job for it requires a background as a ham and as a salesman. The salary is good, consisting of a fixed salary plus a generous commission. The work is demanding . . . a good salesman should never permit a customer to say no. Peterborough is great for living. If you are interested please let me know about your ham background and details of your sales training and experience.

. . . *Wayne*

Letters

advised by my lawyers that
don't you ever proofread y
are a bunch of crooks and
this is the last straw for
have no other recourse but
should be tarred and feath

Friend of the Wayfarers:

Although a newcomer to your subscription rolls may I add my "Amens" to your editorials and policy.

Wandering in a daze in the electronic forest, I find little that I can understand in *QST*. But I have been able to get a great deal out of *73*. Almost every month I find something I would like to build. I can understand what it's all about and usually fits my purse.

Keep up the good work.

Ed Staffan WA8AOD
Midland, Ohio

Dear Wayne:

Congratulations on producing such a good magazine every month: I've seen about eight ham magazines and *73* is way ahead—I guess it's probably the best available! None of this "who worked—who" DX columns and splitting up articles like Brand X does! Sure, they have about one good article a month but at a buck a toss, it's too much. Congratulations to Jim Kyle on his article on screen modulation. Keep *73* like it is!

Peter Chadwick G3RZP
Chelmsford, England

P.S. How do you stop people pinching your copy of *73* before you've read it yourself? That doesn't happen with a Brand X!

Dear Wayne:

Ham radio is my hobby and I pursue it for the enjoyment it brings me. The other night I had a nasty shock when I called a Florida station on 14,240 kc. His answer was rude and arrogant. He stated that he was operating an AM station and that he would not talk to sideband stations below 14,250 kc, however if I chose to get out of his part of the band he would have a short contact with me.

Wayne, who has allocated exclusive frequencies to the few remaining dinosaurs on our twenty meter band? They've had a good ten years to modernize so by now we know that most of the kilowatt AM'ers just don't want to get along.

After that experience I took a few hours to listen to these fellows. Listen yourself to one of the most sickening displays you will find in our hobby. They gather in small groups to tell each other how much they hate sideband. Let's form a posse and get these mentally retarded children off our bands.

An Old Timer

Dear Wayne:

While driving through Ohio last June, I came across the sign in the picture. Thought you might be interested in it.

Stan Rohrer W9FQN

Dear Sirs:

Enclosed is my subscription to *73*, I don't mind telling you that I have been a member of the ARRL for many, many years, but I'm not going to be a member much longer believe me.

I don't know what these people are trying to prove but I can tell you one thing unless we wake up ham radio is going to be a thing of the past.

I was on the air when it was questionable whether a license was needed or not because there were no broadcasting stations other than a few Naval stations. At that time I was in my teens.

Fact is that I watched and kept up with radio from its infancy. I have built my equipment and tried to keep it up to the knowledge of the day. To me this is a hobby. Sometimes I take it pretty seriously, other times I may not be on the air for months.

The ARRL now decides that I'm not smart enough to hold a license that will permit me the privileges that I've enjoyed all these years unless I up my code speed and technical knowledge. Fortunately this wouldn't be very hard for me except I would have to lose a day or more of work, travel 50 or 60 miles to take the exam and pay an additional fee for the exam for what reason. I'm not an engineer. My work has nothing to do with this hobby.

In my mind it's all too clear the ARRL has sold us out before. They have lost a portion of our frequencies time and again. I think this is a prelude to selling us out again.

I think we need another organization to restrain their efforts, and I think this could be easily accomplished. After all, they only represent about ¼ of the amateur body and many hams like myself are dropping out everyday.

Yes, count me in, and I hope you get many more members so that you may voice our opinion and it will be heard. Please excuse the writing as I'm in a hurry, but I just had to tell how some of us feel about upgrading the amateur.

Philip DeMarco W8OSX
Richmond, Ohio

Dear Wayne:

Just a short note accompanying renewal to *73* to assure you the delay was due to a time element, and not a reflection on your editorial policy. Although I don't always agree with you (who does 100%?) I've enjoyed and often benefited from the additional viewpoints presented. It is encouraging to see emphasis placed on constructive attempts to improve the technical competence of those engaged in this pastime of ours; an emphasis I feel is talked about but with sparse action taken by others in the field.

Keep up the good work and if we try hard enough, we may shake ARRL out of the 19th century. Maybe even help them discover *radio telephone* as a mode of operation.

Thomas J. Barker K6MDG
Costa Mesa, California

Wayne Green editor, etc.:

Keep those ridiculous business reply cards from between the pages of 73. You use the same type of binding as does Playboy, and the cards ruin the advantages which this binding affords.

John Boyd WAØAYP
Brookings, South Dakota

Is there absolutely no pleasing you? Here I go to all the trouble to make sure that the reply card was put in the centerfold of the magazine with but one staple holding it so you could pull it right out and send it in with no harm to your magazine and still you complain. Good grief. Look John, you like all those articles in 73, right? And you know that no amount of subscriptions can pay for the publication of our magazine. The advertisers are the ones that are buying you the magazine . . . don't forget it. They will continue to buy your magazine for you as long as you pay good attention to their ads in 73. I'm returning the card . . . please fill it out and send it in to Newtronics and stop trying to sabotage us. By the way, 73 has the expensive saddle-stitched binding like Playboy, the New Yorker and other expensive magazines because it makes the magazine so much easier to read . . . and to lay out on the workbench when you are building. We could probably save quite a bundle if we went to the hard-to-hold-open economy type binding. We could save a lot more if we used the cheap grade of paper used by the other two magazines . . . compare the paper some time and note that 73 is using a much heavier, whiter paper.

Dear Wayne:

Judging from the volume of correspondence on Der Kleiner Keyer Sept. 73, it may be well to advise the readers of several minor technical corrections.

The 5.8k one half watt resistors which may be seen in the photograph and on the component board layout, Fig. 10, are missing from the schematic. These two resistors should be connected in series with each leg of the dual 15k speed control potentiometer as shown below. By having these resistors in the circuit, the minimum resistance of the RC speed control circuit is held to 5.8k. This prevents the maximum speed from exceeding 50 wpm, which speed would not be useful for most hams, HI!

In addition, the 150k resistors in the filter circuit, in the power supply, should be changed to 150 ohms.

It is gratifying to know how many fellows have built this keyer. Many different plans have been used for the monitor oscillator. One which seems to work very well and allows the minimum load on the power supply is that shown near the back of the latest RCA Transistor Handbook (Page 375). A little ingenuity and experimentation will show the constructor how to connect it in with the keyer.

E. L. Klein W4BRS
Huntsville, Alabama

Dear Wayne:

Do you sell names of your subscribers to sucker list users? One amgazine did, using their own stencil so there was no question. I feel they have no right to sell my name to sucker lists just because I subscribe to their publication.

A. S. Johnson K7VQI
Tucson, Arizona

The magazine has the legal right to sell your name. I personally think it is unethical to do this and have never done this with our mailing list, though we could make quite a few fast bucks that way. By the way, if you spell your name just a little differently for each magazine you subscribe to you can find out right away who is selling you out. I only know of one ham magazine that goes in for this practice.

Dear Wayne:

You may be interested to know that I take a dim view of the ARRL and its magazines. To further prove this, I was thumbing through the July 1947 issue of *QST* when suddenly a rash appeared on my face, arms and stomach. This is the honest truth. My doctor said I was allergic to the ink on the pages. I must say that when a magazine "by and for amateurs" gives you a rash, then chances are that it's not worth reading. Keep up the good work in *73!*

Ivan Payne VE3FSQ
Toronto, Ontario

Dear Wayne:

The article by W5VOH on soldering connectors to coaxial cables is a dandy ("The Lowly Coax Fitting," October).

However, the photos make it appear that soldering is being performed on a high-pile carpet.

Take my advice: If you even suspect that your XYL may feel that solder blobs on her favorite carpet don't blend with the decor—move the whole operation to the workbench.

I followed W5VOH's instructions—on the workbench. Results? (without a carpet?)—Excellent.

Stephen Grossman W2YGA
New York, New York

Sirs:

The article by W5VOH on the lowly coax fitting in the October 1965 issue of *73* is very good and the pictures excellent, but one small change will make it much better.

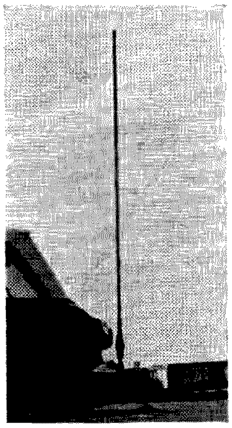
In step No. 1, the cut should be made ⅜ inch from the end of the fitting toward the threads.

Follow W5VOH's step 2-3-4-5.

In step No. 6, the connector is then screwed onto the outer covering about 3 turns. A very slight amount of moisture on the outer covering will help here. This will bring the braid into view for soldering and will provide a good weathertight seal. Then, of course, a coating of Pli-O-Bond will insure that no moisture will get inside the fitting. Hope that you can print this soon, before there are a lot of wet coax connectors around.

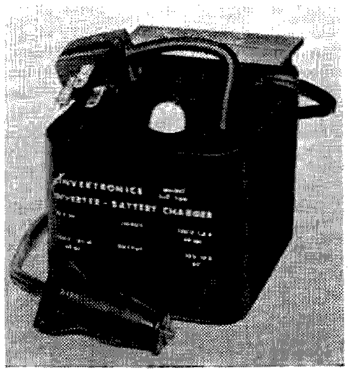
Thomas Kolvek WA9CIO
Roselle, Illinois

NEW PRODUCTS



High Power Mobile Antenna

Running high power mobile—or thinking about it? Mark Products has a new line of heavy duty Heliwhips for 40 through 10 that can handle 1000 watts of rf. They're a perfect match for the growing high power of the transceivers. Numbers are the KW-40, 20, 15 and 10 and they're $17.50 each from Mark distributors. For more information, write Mark Products, 5439 W. Fargo, Skokie, Illinois 60076.



Invertronics Inverters

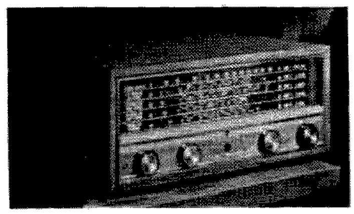
If you need a special-purpose (or regular) inverter, you ought to check with Invertronics. Their clever catalog contains all sorts of interesting ones. They've got one for 6 to 12 volts, 12 volt positive ground to 12 volt negative ground, 12 volt to 28 volt (use that surplus without modification), 12 volt to 120 AC 60 cycle and 400 cycle, and 12 volt to 250, 350 or 450 volts. Inverters are rated at 150 to 300 watts. If you're the builder—cheapskate type, they sell the transformers, too. Everything is reasonably priced. Invertronics, P.O. Box 342, Pine Brook, N.J. 07058.

CC Crystal Filter

Many hams who have wanted to build an SSB receiver, transmitter or transceiver have been discouraged by the high cost of most crystal filters, even though high frequency filters have a lot of advantages to offer over mechanical filters. And most hams are very hesitant to try to build their own since they require etching, grinding, critical adjustments, etc. Now you don't need to worry about that any more. CC Electronics is making high quality crystal filters similar to those in popular SSB transceivers for only $17.50. Their center frequency is 3 mc, the bandwidth is 2.9 kc at 3 db and the shape factor, 50/3 db, is 2.8:1. Ultimate attenuation is 55 db and insertion loss is only 2 db, while passband ripple is 1 db maximum. Input and output impedances are 3.9 k. The filter comes in a small hermetically sealed package with suggested schematic. For more information—or to order a filter—write CC Electronics, 12017 West 92, Lenexa, Kansas.

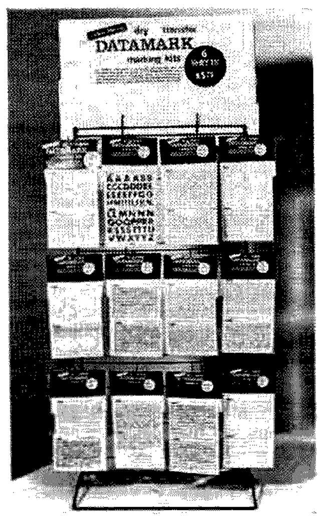
Electro-Voice Mikes

These new E-V base station mikes have a lot to offer. The cases are two pounds of solid die cast metal finished in attractive communications gray. They have a choice of locations for the DPDT telephone type leaf switch so that you can use touch-to-talk or push-to-talk. And you can choose PTT or vox at the end of the cable without digging into the mike. It comes in two models: The 619 ($28.50 ham net) in Hi-Z dynamic and features a response of 70 to 10,000 cycles at −57 lb output. The 719 ($16.50) is ceramic and has a response of 80 to 8000 cps at −56 db. See them at your distributor or write Lynea Dalrymple at E-V, 635 Cecil Street, Buchanan, Michigan.



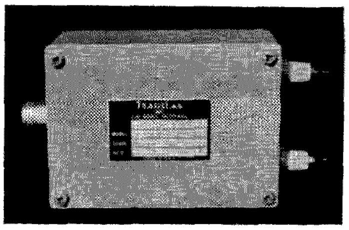
SWL Receiver from Hallicrafters

The new Hallicrafters S-200 Legionnaire looks awful nice for the SWL and others who want to be able to listen to foreign SW broadcasts without worrying about the critical tuning of most SW receivers. It covers the very popular 49, 31, 25 and 19 meter bands as well as the regular broadcast band. Since these bands have most of the foreign broadcasters, and are spread out on the S-200 you can tune the world as easily as the local broadcast stations. The S-200 is in an attractive walnut wood-grain steel cabinet so you can leave it in the living room if you'd like. More information from Mr. Bernard Golbus, Hallicrafters Co., 5th and Kostner Avenues, Chicago, Illinois 60624.



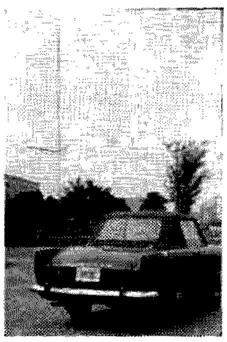
Datamark

Datak is now making their very useful rub-on lettering in inexpensive packs in a wide range of subjects. Each pack is $1.95 and typical sets are for "amateur radio," "audio, TV and hi fi," "experimenter, home and intercom," "industrial and test equipment," etc., as well as complete alphabets and number sets in various sizes. All sets are available in black or white and the alphabets also come in gold. You can get them at your distributor or from Datak, 63-71st Street, Guttenberg, N.J.



Translab Broadband Balun

The new Translab Ferrite Balun exhibits nearly perfect SWR characteristics across the HF bands from 2 to 30 mc. It's even good on 6! Power rating is 2 kw PEP and the balun is available in two models: 1:1 for 50 ohm balanced to 50 ohm unbalanced and 4:1 for 50 to 200 ohms or 75 to 300 ohms. It's completely sealed and even uses a type N connector for the coax connection since UHF ones aren't weatherproof or constant impedance. Price is $19.95 and complete data is available from Translab, Inc., 4754 Federal Blvd., San Diego, California 92102.



40 Meters on the HW-3

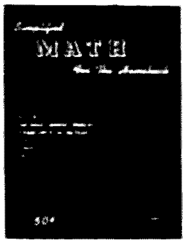
Mark Products has brought out a new 40 meter element for their popular HW-3 Triband mobile antenna. It screws into the top of the HW-3 giving a choice of three bands from 40 to 10 for mobile use without any mechanical or electrical switching. The basic HW-3 is $19.50 and the HW-3/40 element is $7.95. More information from Joseph Schroeder, Mark Products, 5439 W. Fargo Ave., Skokie, Illinois 60076.

Do It Yourself (Almost) QLS's

An interesting idea from the Roland Company. You send them 50¢, they send you a kit for designing your own QSL's. The kit includes various alphabets, decorations, report forms, samples, etc. Then they'll print up your own custom cards for you. Roland Company, Dept. 73, 1270 Avenue of the Americas, New York, N.Y. 10020.

73 Books

RECEIVERS. K5JKX.—If you want to build a receiver or to really understand your receiver, this is the book for you. It covers every aspect of receiving in author Kyles usual thorough manner. **$2.00**



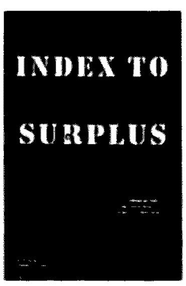
SIMPLIFIED MATH FOR THE HAMSHACK —K8LFI.—This is the simplest and easiest to fathom explanation of Ohm's Law, squares, roots, powers, frequency/meters, logs, slide rules, etc. If our schools ever got wind of this amazing method of understanding basic math our kids would have a lot less trouble. **50¢**

CW—W6SFM.—Anyone can learn the code. This book, by an expert, lays in a good foundation for later high speed CW ability. **50¢**

FREQUENCY MEASURING—WØHKF—Ever want to set yourself up to measure frequency right down to the gnat's eyebrow? An expert lets you in on all the secrets. Join Bob high up on the list of Frequency Measuring Test winners. **$1.00**

CARE AND FEEDING OF HAM CLUBS—K9AMD.—Carole did a thorough research job on over a hundred ham clubs to find out what aspects went to make them successful and what seemed to lead to their demise. This book tells all and will be invaluable to all club officers or anyone interested in forming a successful ham club. **$1.00**

ATV ANTHOLOGY. WØKYQ and WA4HWH.—A collection of the construction and technical articles from the ATV Experimenter. Includes a complete, easy to build vidicon camera and 50 other projects. The only book available about ham TV. **$3.00**



REVISED INDEX TO SURPLUS—W4WKM. —This is a complete list of every article ever published on the conversion of surplus equipment. Gives a brief rundown on the article and source. Complete to date. **$1.50**

TEST EQUIPMENT HANDBOOK. W6VAT.—Every ham needs to have and know how to use test equipment. This book tells you how to make valuable ham test gear easily and cheaply. It also covers the use of test equipment. **50¢**

73 Magazine
Peterborough, N.H. 03458

Caveat Emptor?

★ **Price—$2 per 25 words for non-commercial ads; $5 per 25 words for business ventures. No display ads or agency discount. Include your check with order.**

★ **Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.**

★ **We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.**

★ **For $1 extra we can maintain a reply box for you.**

★ **We cannot check into each advertiser, so Caveat Emptor . . .**

WRL BLUE BOOK PRICES save money on quality used gear. Take 10% off without trades. G76-$179.00; Sidewinder 2 m-$299.00; 62S1-$650.00; 32V1-$149.00; Apache-$149.00; Valiant-$199.00; HT-37-$269.00; SB-400-299.00; Invader 200-$285.00; 200V-$499.00; HT-41-$229.00; Loudenboomer-$299.00; Pro 600JX-$199.00; SX101A-$219.00; SS1R-$545.00; HO-10-$55.00 and hundreds more. Free list: Leo WØGFQ, Box 919, Council Bluffs, Iowa.

AUDIO Q5ER Filter cuts off above 3300 cycles. 500 ohms, 20 watts, UTC new surplus 2/$5. AC line filters 3A WECO 2/$1. Tone filters 2685 cycles, 70 cy wide Burnell 2/$5. L-C Electronics, Box O, Freeland, Michigan.

WANTED: Military or commercial surplus . . . airborne, ground and testsets. Try the BIG BOYS, then write or call us collect AREA 703-560-5480 and give us YOUR price . . . We pay cash and freight. Dun and Bradstreet rated . . . RITCO, POB 156, Annandale, Virginia.

COLLINS KW-1 DELUXE TRANSMITTER. 1000 watts AM or CW. Would make fine SSB linear. $1400 or make offer. George F. Norton, W4EEE, Georgia University Station, Athens, Ga.

HEATH HW-32 20 meter transceiver with HP-13 power supply, calibrator, mike, speaker, new warranty, $140. W2NTZ, R. Stevens, 3048 Wilson Avenue, Bronx, N.Y. 10469

BUILDERS—A 4-1000A, class B, grounded grid final. Complete drawings with two 8 x 10 photographs, detail schematic diagram and specifications. Easy to construct; cost under $300. Price $7.50. Bill Brown WØSYK, 28 Marine Lane, Hazelwood, Mo.

SALE TO RAISE TUITION: National NCX-3 ($225). NCXA ($75). Heath Sixer ($40) and 6/12 vdc ($40). All excellent. Tony Curtis, P.O. Box 102, Center Hall, Pennsylvania.

QSL, SWL, WPE CARDS. Sample catalog 10¢. 12 pt Kromkote cards, some originals. Nicholas and Son Printery, P.O. Box 11184, Phoenix, Arizona 85017.

TOOOOBES, TRANSMITTING-SPECIAL PURPOSE. New boxed, guaranteed . . . 6CW4-$1.40, 6146-$2.55, 417A-$3.95, 826-$6.00, 6360-$3.45 . . . Free catalog . . . Vanbar dist, Box 444X, Stirling, N.J. 07980.

PLATE TRANSFORMERS 690 v at 450 ma. No CT, perfect for bridge or doubler supplies. 117 vac primary. $3.95 plus postage. Wt. 19 lb. A.R.C. Sales, P.O. Box 12, Worthington, Ohio.

SONAR 20M SSB/CW transceiver with matching AC power supply. Covers entire band with 300 watts PEP input. $155, Steve Weirich, 1407 Linden Blvd., Brooklyn 12, N.Y.

SPECIAL FILAMENT TRANSFORMER for 4-400A and 4-1000A, etc. 120 volt, 60 cycle primary. Two secondaries: 7.6 v @ 21 amp and 5.1 v @ 13 amp. Unused and sealed. $4.50 plus postage. Wt. 14 lb. A.R.C. Sales, P.O. Box 12, Worthington, Ohio.

COLLINS 75S-3B, 32S-3, 516F-2 AC supply. Late serial number. Less than 5 hours time. $1200 firm. Perfect. Send MO or certified check. TH6-DX beam in carton, new $100. W. E. Lyons, Sr., 4200 Lorna Place, Las Vegas, Nevada.

COLLINS KWM 2. New one. Serial 13846-Trade for S Line, etc. Also new TR-4, $495. Want TX-4 or T-4 Reciter. Also have 15 ft. runabout boat rig. Trade for ham gear. WA4LXX, 251 Collier Ave., Nashville, Tenn. 37211.

CRYSTAL FILTERS. 3.0 mc center frequency, 2.8 kc bw at 3 db. 7.8 kc bw at 50 db. Loss 1 db, 3.9 kc termination. 1-9/16 L x 1⅜ W x 1¾ H. $17.50. CC Electronics, 12017 W. 92 St. Lenexa, Kansas.

COLLINS S-LINE 32S3, 75S3B, 516F-2 AC power supply. All less than one year old, like new. Lot price $1000. WA4LUN, Box 238, Troutman, N.C. Phone 528-5246.

HAMMARLUND HQ 110A, Communicator two meters, Health Sixer, send stamp for list of extra gear, some VHF, all good. W8FZ, 4328 State, Saginaw, Michigan 48603.

COLLINS S-LINE for sale: 75S-1, 32S-1, 516F2 and 30L-1 bought in 1965. Asking $1300 or sell separately. WB2FFK, 288 Fourth Avenue, East Orange, N.J. 07017.

PRINTED CIRCUIT materials. Three sample pieces and details. One dollar. Betty Lou Nolin, 35 Arbor Drive, New Hartford, N.Y. 13413.

ART'S QSL'S Samples 10¢. Art Bliss, 1829 N. Catalina St., Burbank, California.

CONVERTERS $10 and up. World's largest selection of frequencies. Ham TV vidicon cameras and parts at low factory-direct prices. See them all now in our full page ad in this issue. Vanguard Labs, 196-23 Jamaica Ave., Hollis, N.Y. 11423.

GIANT 20th ANNIVERSARY CATALOG. Increase your product category. TV cameras, electronic equipment, kits, Hi-Fi, components. Free copy. Denson Electronics, Rockville, Conn.

FM EQUIPMENT SCHEMATIC DIGEST

A comprehensive collection of Motorola schematic diagrams covering low band, high band and 450 mc equipment manufactured between 1949 and 1954. Crystal formulas, alignment instructions and a wealth of technical data is included in the 92 pages. Price $3.95

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BUY 100 FOR $4.00 or 1000 FOR $35.00 PREPAID

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4CX 250F	26.5v filament, BRAND NEW, reboxed	**$5.50**
socket	for above, teflon, gold plated pin connections. Less by-pass. BRAND NEW	**$3.50**
combination	both above special	**$8.50**
TU-7	Tuning unit, for BC-375, 4500 to 6200 KC. Loaded with hi-voltage transmitting variables, micas, coils, RF switches, verniers, ETC. 10 LBS.	**$2.50**
130 mf 25v DC.	Tantalum, SPRAGUE #CE13C131F. ½" dia. 1⅝" long. Pigtails. NEW	**50¢ ea. 4/$2.75**
400 PIV 18A	MOTOROLA #MR-326 & MR-326R, on heat sink 3¼" x 1¼". BRAND NEW	**$1.25 ea. 4/$4.75**

CABINETS discontinued HEATHKIT

All are gray crackle finish, except as noted; all are less front panel; all, except*, have a 1" hole for power plug; all, except#, have 4 holes, in bottom, for mounting feet. BRAND NEW.

type #	h	w	d	wt.	exceptions	price
39	4½	7½	4	1 LB		39¢
110	4½	7½	4	1 LB	*has 2 ½" holes	39¢
238	6½	9½	5	3 LB	ventilated	59¢
110	9½	6½	5	3 LB	#ventilated	59¢
24	8½	13	7	4 LB	ventilated	79¢
96	8½	13	7	4 LB	ventilated, louvers	79¢
89	8½	13	6	4 LB	ventilated	79¢
95	6½ 2¾" x 9¾" opening in back.	13	10	7 LB	shiny green, 2" power plug hole, ventilated heavy gauge steel.	$1.00

All orders, except in emergency or I'm at a hamfest, shipped same day received. For free GOODIE" sheet, send self addressed stamped envelope—PLEASE, PLEASE—include sufficient for postage & insurance. Any excess returned with order.

B C Electronics
Telephone 312 CAlumet 5-2235
2333 S. Michigan Ave. Chicago, Illinois 60616

TWO-WAY
COMMUNICATION CRYSTALS
AMERICAN CRYSTAL CO.
PO BOX 2366 KANSAS CITY, MO.

IT'S SUPERCALIFRAGILISTICEXPIALIDOCIOUS! Free new catalog of etched circuit boards, radio books and information on Kit-of-the Month Club. Leader Enterprises, Box 44718-KH, Los Angeles, Calif. 90044.

TV CAMERAS. Model 400 complete with good vidicon and lens. Used as demonstrators. Only $200 FOB Vanguard Labs, 196-23 Jamaica Ave., Hollis, N.Y. 11423.

NOVICE CRYSTALS. 80-40 M $1.05 each. Others 75¢. Free list. Nat Stinnette W4AYV, Umatilla, Fla. 32784.

COMPLETE HAM STATION: Halicrafters SX-110 receiver; Heathkit DX-40 transmitter and a 20' vertical antenna. Like-new conditior $140.00. Telephone in New York 377-3451.

WE WILL PAY CASH: Wanted, popular, late model unmodified amateur equipment. Highest prices paid for clean, good operating gear. Write Graham Radio, Dept. 10, Reading, Massachusetts.

CLOSEOUT discontinued full size beam, new ⅞" and 1" aluminum. Three element 20 meter, $22, Two element, $16. Three elements on 15 meters, $16, two elements, $12. Express collect shipment. Gotham, 1805 Purdy, Dept. 73, Miami Beach, Fla.

ARE YOU SINCERE? Are you *really* looking for the best deal on a new or fully guaranteed used unit? Let us convince you with a specific quote that will *really* save you money. Graham Radio, Dept. 10, Reading, Massachusetts.

GLOBAL WRIST WATCHES. Feature 24 hour world time conversion. Free brochure. Mention 73. Nordlund, 7635 West Irving Park, Chicago, Illinois 60634.

PROTECT LOW NOISE RECEIVERS. Solid state and tube front ends can be damaged or destroyed by transmitter leakage. Prevent this with broadband receiver protectors. Two models: RP-1 for 80 through 6 meters, and RP-2 for 6 through ¾ meters. Details in brochures RP-1 and RP-2. Radiation Devices Company, P.O. Box 8450, Baltimore, Md. 21234.

TUNAVERTERS! Transistor 6-1 tuning calibrated converters for AM-CW-SSB! Half a mobile station $19.95-$24.95! Sensitive, selective, tunable BFO! Marine, amateur, SW bands! Herbert Salch and Co., Woodsboro, Texas.

SBE 33 with mobile bracket $225; SB1LA 1000W linear $175; Gonset Communicator III with pre-amp, 10 crystals $175; Excellent condition, K7UFD, P.O. Box 212, Sparks, Nevada.

ELMAC AF68 station, PMR8 receiver, 12/120 volt supply. Like new $300 ppd. Will include big junk box if you pay postage. Write first. Leo Boisvert W1HIE, Exeter Road, Newmarket, N.H.

HONOLULU HAMS! Have gone transceiver operation. Have Heath SB-400 factory checked $275. Globe Champion 350 for $75. Glad to demonstrate. Local only. KH6EWA Waikiki.

FOR SALE: R23/ARC 190-550 kc receivers good operating with tubes, $15.50. Also R445/ARN30 tunable late type command receivers 108-132 mc. Same power set up as command sets. Good operating, $25.00. RITCO, POB 156, Annadale, Va.

Get Rich! Get Smart! Get Gear!

Want to buy, find out or sell? Caveat Emptor? will do it for you. 73's want ads are cheapest at only $2 for 25 words non-commercial, and you know they're the most effective since 73 is read by the active, money-spending hams.

And for businesses, only $5 for 25 words—not $8.75 as in Brand X. Yearly rate is $50 in advance for 25 words per month. For either type of ads, you can prorate to the nearest $1 (minimum $1) if you don't have exactly 25 words. We aren't nasty about counting the words.

A few hints: Type copy. We aren't responsible for errors caused by illegibility. Don't abbreviate; you pay for words, not space. Include your full name and address as well as call; not all hams have a Callbook. Since we capitalize and bold face the first few words, make them important and attract attention. Don't put "For Sale" in the ad; everyone knows that's what it's for if it doesn't say otherwise.

Here's my ad:

Send to Caveat Emptor

73 Magazine, Peterborough, N.H. 03458

R390A RECEIVER excellent condition with manual. $600, J. Larson, 330 N. Saltair Avenue, Los Angeles, California 90049. Phone 213-472-1786.

LITTLE FELLER SSB phasing reactor. See page 100 in October 73. Same used in original article, $1.25 ppd. Radio-Tronics, 50-15 Weeks Lane, Flushing, N.Y. 11365.

COMPLETE SHACK: Clegg Zeus $375, Interceptor $250, Bandit 2000A $300. Excellent condition. WA9EMB, 5721 N. 57th Street, Milwaukee, Wisconsin 53218.

TELETYPE TEST SET I-193C. Government rebuilt, still crated. Tests RTTY transmitters, converters, relays. $14.95 each, two for $27.40. F. O. B. Harrisburg, Pa. Satisfaction guaranteed. Telemethods International, 3075 E. 123rd Street, Cleveland, Ohio

INDEX TO ADVERTISERS

Propagation Chart

December 1965

J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7*	7	7	7	7	7	7#	14	14	14	14
ARGENTINA	14	7*	7#	7	7	7#	14	14	21	21	21*	21
AUSTRALIA	14	14	7#	7#	7#	7	7	7*	7#	7#	14	14
CANAL ZONE	14	7	7	7	7	7	14	14	14	14*	21	21
ENGLAND	7	7	7	7	7	7	14	14	14	14	14	14
HAWAII	14	14	7#	7	7	7	7	7#	14	14	14	14
INDIA	7	7	7#	7#	7#	7#	14	14	14	14	7	7
JAPAN	14	7#	7#	7#	7#	7	7	7	7	7	7#	14
MEXICO	14	7	7	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	7#	7#	7#	7#	7#	7	14	14	7	7#	14
PUERTO RICO	14	7	7	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	7*	7	7	7#	7#	14	14	14	14	14	14*	14
U. S. S. R.	7	7	7	7	7	7#	14	14	14	14	7#	7
WEST COAST	14	14	7	7	7	7	7	14	14	14	14	14

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	7	14	14	14	14
ARGENTINA	14	14	7#	7	7	7#	14	14	14	21	21*	21
AUSTRALIA	14	14	7#	7#	7	7	7	7*	7	7#	14	14
CANAL ZONE	14	7	7	7	7	7	14	14	14	14*	21	21
ENGLAND	7#	7	7	7	7	7#	14	14	14	14	14	7*
HAWAII	14	14	7*	7#	7	7	7	7#	14	14	14	14
INDIA	7	7#	7#	7#	7#	7#	7#	14	14	14	7*	7
JAPAN	14	14	7#	7#	7#	7	7	7	7	7#	14	14
MEXICO	14	7	7	7	7	3*	7	14	14	14	14	14
PHILIPPINES	14	14	7#	7#	7#	7#	7	14	14	7	7#	14
PUERTO RICO	14	7	7	7	7	7	14	14	14	14	14*	14
SOUTH AFRICA	7	7	7	7#	7#	7#	14	14	14	14	14	14
U. S. S. R.	7	7	7	7	7	7#	14	14	14	14	7#	7#

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7*	7	7	7	7	7	14	14	14	14
ARGENTINA	21	14	7#	7	7	7	7#	14	14	21	21	21*
AUSTRALIA	21*	21*	14	7#	7	7	7	7	7	7#	14	21
CANAL ZONE	14	14	7	7	7	7	7	14	14	14	21	21*
ENGLAND	7#	7	7	7	7	7#	7#	14	14	14	14	7#
HAWAII	21	21	14	7	7	7	7	7	14	14	14	14*
INDIA	14	14	14	7#	7#	7#	7#	7#	14	14	7	7
JAPAN	14	14	14	7#	7#	7	7	7	7	7#	14	14
MEXICO	14	14	7	7	7	7	3*	7	14	14	14	14
PHILIPPINES	14	14	14	14	7#	7#	7	7	14	7	7#	14
PUERTO RICO	14	14	7	7	7	7	7#	14	14	14	14	14
SOUTH AFRICA	7#	7	7	7#	7#	7#	7#	14	14	14	14	14
U. S. S. R.	7#	7	7	7	7	7#	7#	7#	14	14	7#	7#
EAST COAST	14	14	7	7	7	7	7	14	14	14	14	14

Very difficult circuit this hour.
* Next higher frequency may be useful this hour.

Good: 1, 6, 7, 8, 12-15, 21, 22, 24-26, 28-31

Fair: 3-5, 9, 10, 16, 20, 23

Poor: 2, 11, 17-19, 27

VHF DX: 8, 9, 29, 30

got a match?

Definitely not. It's a cold fact that no competitive linear amplifier compares with National's NCL-2000 — regardless of price. Take the time to look at the chart below and plug in the specs of *any* amplifier next to those of the '2000 — not a single competitive unit in the maximum power classification offers even half the features of the NCL-2000:

FEATURE	NCL-2000	COMPETITION
POWER	Entire equipment I.C.A.S. rated for full 1000 watt average, 2000 watt peak input; output tubes and all RF components rated for C.C.S. operation. Power input and efficiency identical on all bands — 80 through 10 meters.	
SIZE	Completely self-contained, including power supply, in desk-top cabinet (dimensions only 7⅝" H, 16¼" W, 12¾" D).	
DRIVE REQUIREMENTS	Adjustable passive grid input and use of high power ceramic tetrodes in final permits drive to full output with exciters delivering as little as 20 watts or as much as 200 watts.	
METERING	Separate rear-illuminated precision D'Arsonval plate and multi-meters for simultaneous measurements.	
ALC	ALC output to exciter for maximum talk-power with greatest linearity.	
SAFETY AND PROTECTIVE DEVICES	Fuses, time delay and plate current overload relays, plate power lid interlock and automatic HV mechanical shorting bar.	
CLASS OF OPERATION	Grid-regulated AB_2 permits easiest tune-up, low drive power for maximum exciter linearity, and protection from destructive peak currents.	
EASE OF TUNE-UP	Internal dummy load in grid circuit makes adjustment of exciter into amplifier possible without turning on NCL-2000 and without radiating a signal.	
STYLING	Award-winning design matches NCX-5 transceiver and complements any equipment.	
GUARANTEE	National's exclusive One-Year Warranty.	
PRICE	Only $685.00.	

The NCL-2000 is a rock-crusher of a rig built to *commercial* standards. That's why you get I.C.A.S.-rated maximum legal power in a one-piece desk-top package, and why you get ALC and drive power compatibility with high quality exciters. It's why you get two precision meters, and sensible protection afforded by proper safety devices. Match the NCL-2000 with all the others before you buy — then see your National dealer for easy terms and trade-in deals.

NATIONAL RADIO COMPANY, INC.

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